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NAVORD REPORT 2668

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SURVEY OF BOTTOM SEDIMENTS IN CERTAIN COASTAL AREAS

14 January 1953

U. S. NAVAL ORDNANCE LABORATORY

WHITE OAK, MARYLAND

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SECURITY INFORMATION

SURVEY OF BOTTOM SEDIMENTS IN CERTAIN COASTAL AREAS

Prepared by:

Henry G. Dorsett, Jr.

ABSTRACT: The bottom sediments of a selected list of coastal areas are described briefly. The selected areas are the British Isles and vicinity, the French west approaches, the Baltic Sea area, the White Sea area, the United States east coast and approaches to the Panama Canal, the Yellow and China Sea areas, and the Mediterranean Sea area. The areas covered by the bottom sediment charts, of which there are more than two hundred, are shown on a World Index Map with a numerical listing of the bottom sediment charts in an appendix. These charts exist either in manuscript form or as printed copies at the U. S. Navy Hydrographic Office. Also included in this report is a list of the harbors being investigated by the Inshore Survey Branch of the U. S. Navy Hydrographic Office and its sub-contractors. The Hydrographic Oceanographic Data Sheets (HODS), a compilation of existing oceanographic information on foreign harbors by the U. S. Navy Hydrographic Office, are listed by areas in an appendix, and a sample HODS for Vladivostok, U.S.S.R., is enclosed.

U. S. NAVAL ORDNANCE LABORATORY
WHITE OAK, MARYLAND

NAVORD Report 2668 14 January 1953

This report is a survey of bottom sediments in certain strategic coastal areas of interest to the ALIEX project. The work was done on foundational research funds (FR-18-53) as a part of the project on Ocean Physics to investigate the literature, collect and organize information, and conduct research in the field of ocean physics. The report has been made as comprehensive as possible with a world-wide list of bottom sediment charts and maps showing their location, a world-wide list of Hydrographic Oceanographic Data Sheets (HODS) on harbors both published and planned, and an extensive bibliography.

EDWARD L. WOODYARD
Captain, USN
Commander

H. J. PLUMLEY
By direction

CONTENTS

CONTENTS
(Cont'd)

APPENDICES

ILLUSTRATIONS

The harbors which have been or are being investigated and the agencies which are conducting the inshore research are as follows:

a. Boston Harbor by the Woods Hole Oceanographic Institution.

b. New York Harbor by Cornell University.

c. Narragansett Bay by the Narragansett Marine Laboratory of the University of Rhode Island.

d. Delaware Bay area by Rutgers University and the University of Delaware.

e. Chesapeake Bay by the Chesapeake Bay Institute of The Johns Hopkins University.

f. Charleston Harbor by the Hydrographic Office.

g. Key West by the University of Miami.

h. Galveston and Port Arthur, Texas, by Texas A. and M.

i Mouths of the Mississippi by Texas A. and M.

j. Balboa and Cristobal, Canal Zone, by the Hydrographic Office.

k. San Diego Harbor by the Scripps Institution of Oceanography.

l Los Angeles by the University of Southern California.

m San Francisco Bay by the University of California.

n. Puget Sound by the University of Washington Oceanographic Laboratory.

Studies planned for the Spring of 1953 are as follows:

o. Searsport, Maine, and Casco Bay, Maine, by the University of Rhode Island.

p. Portsmouth, N. H., by Dartmouth College.

q. Buzzards Bay by the Hydrographic Office.

r. New London, Connecticut, by Yale University.

s. Port Hueneme, California, by the Hydrographic Office.

t. Mouth of the Columbia by the Hydrographic Office.

u. Kodiak, Alaska, by the Hydrographic Office.

v. Pearl Harbor by the Hydrographic Office.

w. Yokosuka, Japan, by the Hydrographic Office.

x. Sasebo, Japan, by the Hydrographic Office.

y. Subic Bay, Philippines, by the Hydrographic Office.

z. Apra Harbor, Guam, by the Hydrographic Office.

Some reports dealing with the bottom sediments in these areas are listed in the Bibliography. Additional harbor areas may be investigated in the future.

The Hydrographic Oceanographic Data Sheets (HODS) are a compilation of existing oceanographic information on foreign harbors, shipping areas, or naval bases which are being compiled by the U. S. Navy Hydrographic Office. A list of the HODS which have already been published or are now being compiled, and HODS planned tentatively are given in Appendix B. As an illustration of the type of presentation of bottom sediment information and other oceanographic data in this series of publications, a sample HODS for the Vladivostok, U.S.S.R., area is enclosed as Appendix C by permission of the Navy Hydrographic Office.

Off the coasts of almost all the major land masses of the world there is a gently sloping underwater continental shelf area ranging in width from 0 to over 800 miles but with an average width of about 30 miles. The depths of this shelf range from zero fathoms to a hundred fathoms or more with a small average slope of only about two fathoms per mile or 0.2 per cent.[1] The continental shelf topography is often quite irregular with ridges, valleys, or submarine canyons marring the smoothness of the bottom. A distinct change in slope characterizes the edges of the continental shelves; the adjoining areas seaward from the continental shelves are called continental slopes. The continental slopes are relatively steep with rugged topography. The underwater area out to 333 fathoms includes all the continental shelf area and part of the continental slope area. Most of the bottom sediment information available is limited to the continental shelf area. This discussion of bottom sediments is limited to seven major coastal areas whose bottom sediments have been fairly well charted.

1. H. U. Sverdrup, Martin W. Johnson, and Richard H. Fleming, The Oceans, Prentice-Hall, Inc., New York, N.Y., 1942, pp. 21, 22.

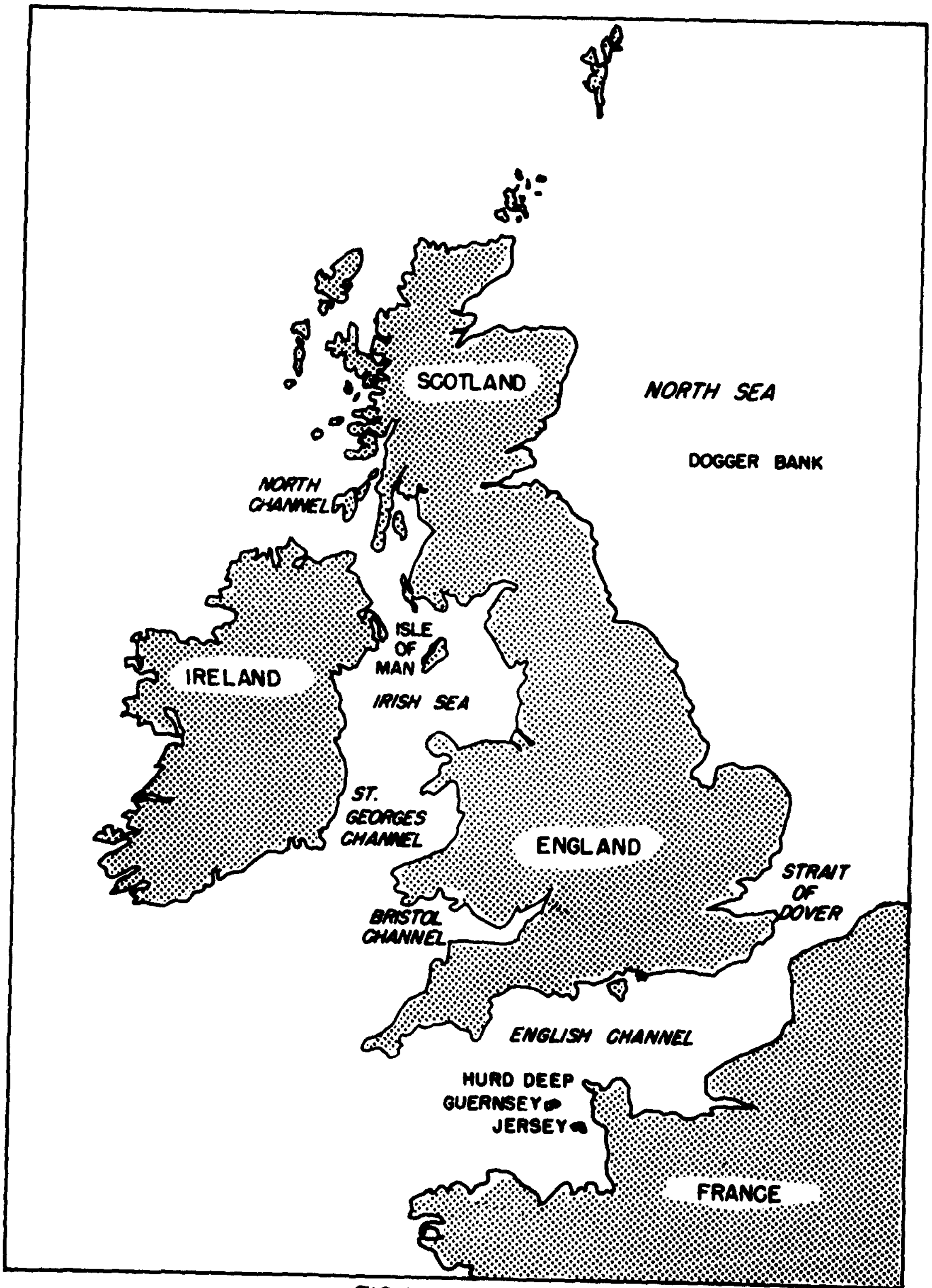

FIG. 1
BRITISH ISLES AND VICINITY

II. Bottom Sediment Survey of the British Isles and Vicinity.

1. General Description of Bottom Sediments and Topography for the Area.

The continental shelf bulges out from the European mainland at the western approaches to the English Channel and is fairly extensive around Ireland and Scotland. The entire North Sea area may be regarded as continental shelf area since this sea is largely less than one hundred fathoms deep. The continental shelf edge around the western coast of the British Isles is close to the one hundred fathoms contour line. Although the area between the fifty fathoms line and the one hundred fathoms line is extensive around the British Isles, the bottom is generally not flat but appears to consist of numerous deep hills and valleys. The bottom sediments are generally patchy and quite variable with sand, mud, gravel, stones, and pebbles, comparable to the type of sediments usually found off former glaciated coasts. Strong currents in the English Channel and around the Irish and Scottish coasts have exposed large areas of rocky bottom, but in the Irish Sea and in many of the bays around the British Isles mud is dominant.

2. English Channel Sediments and Topography.

The bottom sediments in the English Channel consist of extensive areas of rock and much gravel and sand, but little mud where currents of several knots are common. The bottom topography is irregular with many troughs. One of the most prominent troughs found in the English Channel is the Hurd Deep which extends thirty to forty fathoms below the surrounding bottom in two trenches, one with a rocky bottom and the other covered with coarse sand and gravel. The depths along both coasts of the English Channel drop rapidly to about twenty fathoms and the bottom sediments are rocks or fine sand near the coasts. Depths in the inner English Channel area are usually less than 50 fathoms except in the troughs, while the offshore edges of the continental shelf has depths of 70 to 90 fathoms. Coarse sand and gravel with stones predominate out in the English Channel. The Channel Islands such as Guernsey and Jersey are surrounded by rocky bottoms. Where the eastern end of the English Channel widens out into the North Sea, the bottom sediments are dominantly sand with stones, gravel, shell, and mud.

3. Sediments and Topography around the Coasts of England and Scotland.

Along the eastern coast of England, the dominant type of sediment is fine sand. There is some shallow water (less than five fathoms) due to numerous banks of which the most famous is perhaps the Dogger Bank (minimum depth about ten

fathoms). North of Dogger Bank, along the east coast of Scotland, the topography is more regular with depths that are almost uniformly forty fathoms. Down the west coast of Scotland the depths become greater being generally about a hundred fathoms. The bottom sediments become far more varied and irregular with coarse sand, gravel, rocky bottom and stones near the land points. In the deep bays and inlets the bottom sediment is mud. The North Channel between England and northern Ireland leading to the Irish Sea has bottom sediments of gravel and coarse sand with rocky patches and stones along the narrow parts where the current is greatest. Further south where the channel is wider and the currents correspondingly less swift, the bottom sediments along the central portions of the North Channel are mud while coarse sand and gravel with some rocky bottoms are still found along the coasts. The Irish Sea bottom sediments are predominantly mud in the central parts, but around the shores the bottom sediments are very patchy with sand, gravel, stones, shells, and mud. Depths average about thirty to forty fathoms with many underwater hills and valleys. The southern entrance to the Irish Sea, St. Georges Channel and the Bristol Channel, have the same type of patchy underwater sediments, but with more sand and less mud.

4. Sediments and Topography Off Southern and Western Ireland.

Water depths off the southern and western coasts of Ireland are greater than those on the eastern coast. The fifty fathoms line is far from shore on the southeastern coast of Ireland, but is much closer to shore on the south-western and western coasts. Mud is found in the bays along the coasts of southern and western Ireland, but coarse sand and gravel dominate the bottom sediments offshore with many groups of rocky patches, stones, and fine sand. The edge of the continental shelf off the west coast of Ireland is found at depths of about a hundred fathoms. Many hills and ridges characterize the edge of the continental shelf.

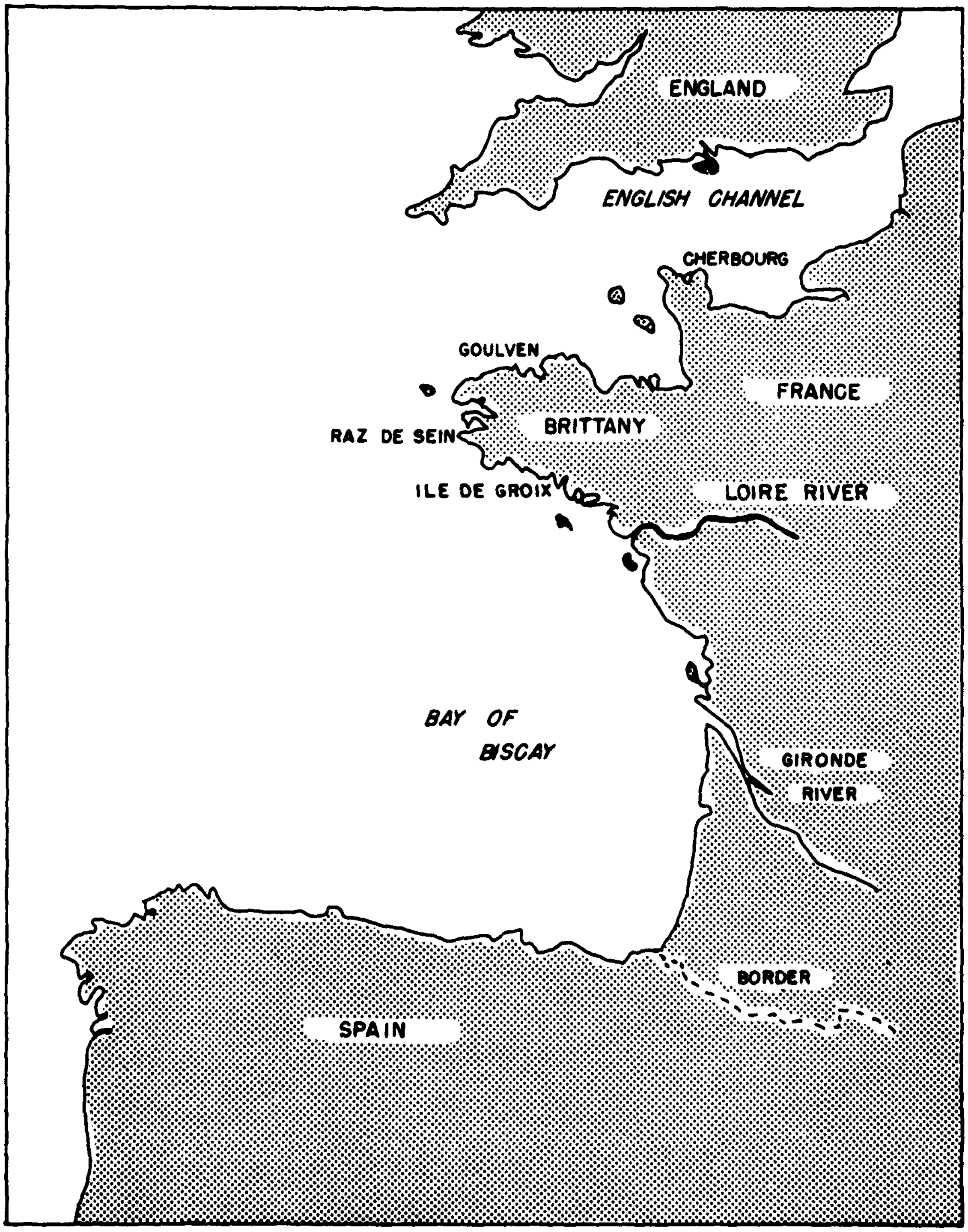

FIG. 2
FRENCH WEST APPROACHES

III. Bottom Sediment Survey of the French West Approaches.

1. General Description of Topography and Bottom Sediments for the Area.

Rocky bottoms characterize the coasts off Brittany on the northwest coast of France. Submerged extensions of the peninsulas off this coast are extensive level rock platforms, unusual in their constant depth and flat topography. Outside the rock platforms, sand is the dominant bottom sediment offshore to the continental slope. The continental shelf takes an outward bulge at the English Channel, being very wide, and continues down the west coast of France with a general decrease in width until near the French-Spanish border where it becomes very narrow because of the presence of a submarine canyon. Off the coast of Brittany, the depths of the continental shelf are greater than 60 fathoms nearshore and the edge of the continental shelf occurs at about 90 fathoms. Flat regions about 7 fathoms in depth are found around the mouths of the Gironde and Loire Rivers. The continental shelf edge runs south-eastward in a nearly straight line offshore from Brittany, gradually narrowing from about 100 miles wide at the Loire River to about 30 miles wide near the French-Spanish border. Extensive portions of the continental shelf have depths up to 70 fathoms along the French coast. Although the near-shore part is fairly smooth, the outer portion of the continental shelf contains many hills and valleys. Offshore and parallel to the coast, extensive mud banks parallel to the coast are found with gravel and sand both inside and outside of the mud banks.

2. Bottom Sediments and Topography from Cherbourg to Goulven.

The bottom sediments from Cherbourg to the continental shelf edge off the western entrance of the English Channel are patchy mixtures of coarse sand and gravel, rocky bottom, fine sand, and very little mud. The bottom topography is very irregular with prominent troughs such as the Hurd Deep which has banks with a drop of 30 fathoms. The banks have rocky bottoms. Along the coast the bottom is rocky with some sand. Offshore in the English Channel the dominant bottom sediment seems to be course sand and gravel with occasional rocky patches, probably determined by the swift currents and the irregular topography.

3. Bottom Sediments and Topography Off Northwest France, Goulven to Raz de Sein.

Extending out from the west coast of Brittany are underwater rock platforms with smooth rock bottoms at constant depths. Nearer shore on the platforms the bottom

is rough and irregular with strong tidal currents. The inlets have bottom sediments of soft sand and occasional mud. From Raz de Sein to the Gironde River the continental shelf is about 90 miles wide with depths of sixty to seventy fathoms. Outside the rocky platforms, the principal bottom sediment is sand or coarse sand and gravel.

4. Bottom Sediments and Topography from Raz de Sein to Ile de Groix off the French West Coast.

Level rock platforms are found underwater off Raz de Sein and southwest of Ile de Groix. Other rock bottoms are prevalent along the coast, but they are much rougher and more broken in topography. Along the coast opposite Ile de Groix, sand and gravel bottoms extend offshore with occasional stones. From the latitude of Ile de Groix (47°40'N) to the latitude of the mouth of the Gironde River (45°50'N), a mud bank extends in a southerly direction about 170 miles with a width of about 20 miles. On the eastern limits of the mud bank, large stone and sand areas form a transitional zone to the rocky bottoms off the coast and to the west the underlying stone and sand beds appear out to the edge of the continental shelf.

5. Bottom Sediments and Topography along the West Coast of France from Ile de Groix to the Spanish Border.

Around the mouths of the Loire and Gironde Rivers flat mud-and-sand regions are found with depths of about 7 fathoms, with rocky bottoms along shore to the north and sandy bottoms along the shore to the south. The large mud bank to the north of the Gironde River mouth is bordered on the south by portions of rocky bottom. A second mud bank extends about 40 miles from the mouth of the Gironde River in an east-west direction. Southwest of the second mud bank, fine sand mixed with stones is found. On the continental shelf offshore from the mud banks much coarse sand and gravel is found at depths of about 80 fathoms with many irregularities in bottom topography which indicate underwater hills and valleys. South of 45°N latitude, the continental shelf breaks sharply inward toward shore for about 35 miles, then extends parallel to the shore as far as the French-Spanish border where a submarine canyon extends along the Spanish coast close to the shore. South of the Gironde River, the rocky coastal bottom changes to sand, sand-and-mud, or mud. The continental shelf along the Spanish coast south of the submarine canyon has bottom sediments of rocky bottom and gravel mixtures nearshore and sand-and-mud offshore at depths of about 70 fathoms.

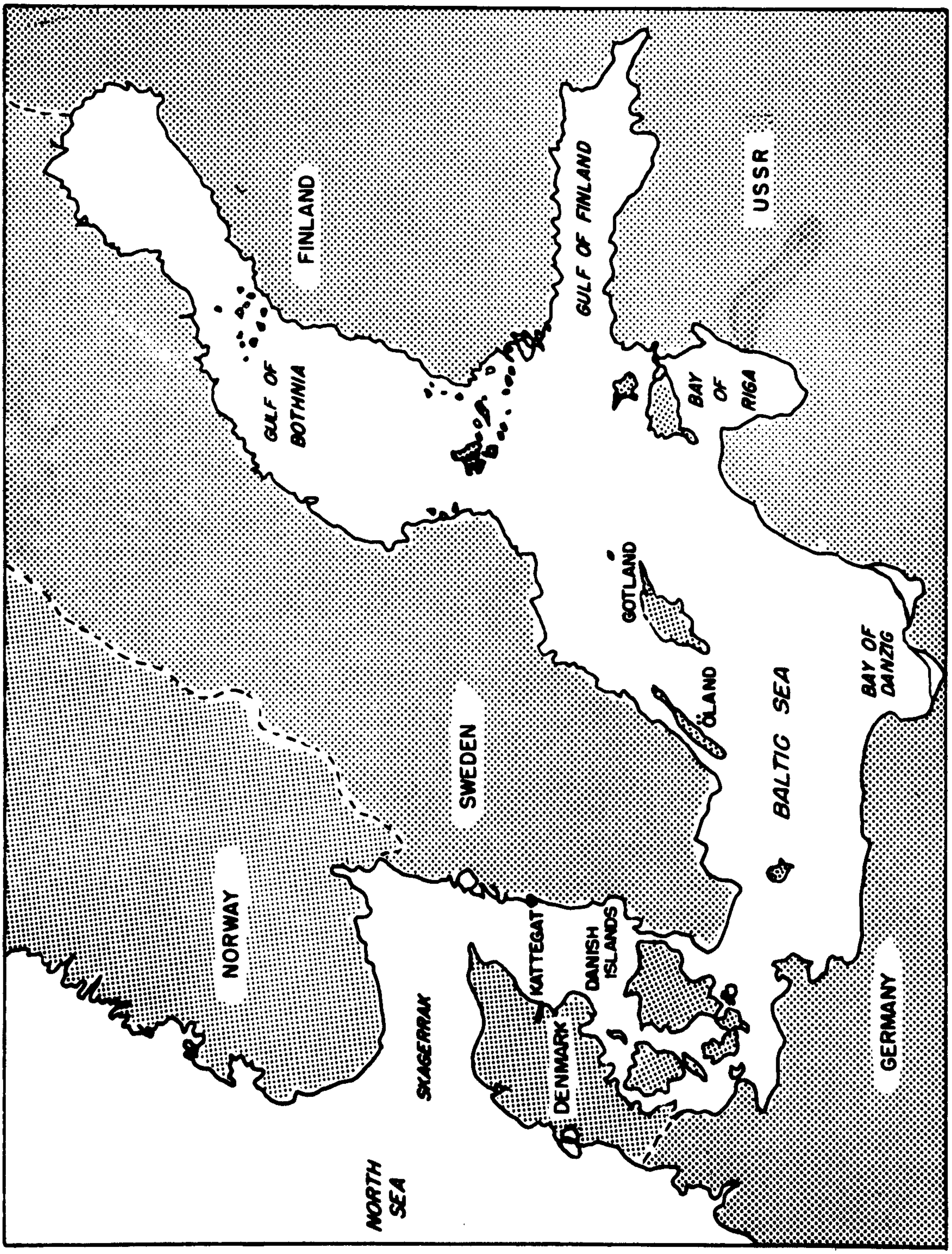

FIG. 3
BALTIC SEA AREA

IV. Bottom Sediment Survey of the Baltic Sea Area.

1. General Description of Bottom Sediments and Topography of the Area.

The Baltic Sea is an inland sea with small outlets to the North Sea through the Danish Islands and the Kattegat and Skagerrak Straits. Depths in the Baltic Sea are less than a hundred fathoms except for a few deep basins. Much of the area has depths of less than fifty fathoms. The bottom sediments consist generally of sand, gravel and stones around the shores, and mud, clay, or marl in the deeper middle areas. The gravel and stones occur in irregular patches in the sand, with isolated stones probable. Regions of clay or marl may occur with thin coverings of sand, silt, or mud. The mud on the bottom of the Baltic Sea areas contains a high organic content which makes it more foul-smelling and slimy than muds with low organic content. Many lighthouses are located along these shores; their existence indicates that difficult navigational hazards are present.

2. Regions connecting the Baltic Sea to the North Sea.

The North Sea end of the Skagerrak is relatively very deep along the south coast of Norway with most of the area over a hundred fathoms deep and some places with depths over four hundred fathoms. This deep bottom area has a covering of silt or mud. The bottom along the north side of the Skagerrak is rocky, whereas along the south side there is a gradual sandy slope out to about 20 to 30 fathoms. The sandy area becomes gradually less extensive and is fairly narrow at the point of northern Denmark. On the eastern coast of Denmark in the Kattegat Strait, the depths are relatively shallow, about 30 fathoms or less, with some depths of over 50 fathoms. The sediments are far more irregular than those off the west coast of Denmark. Shallow sandy bottom is found in the western part of the Kattegat and deeper muddy bottom in the eastern part. Many patches of gravel and stony bottom are scattered over other areas of Kattegat Strait. In the narrow, shallow straits and waterways around the Danish Islands, the bottom sediments are very irregular with sand, mud, gravel, and stony bottom in small patches. Hard clay patches are present and stones are reported in many areas, particularly around gravel patches. Depths are generally less than 15 fathoms.

3. The Middle Baltic Area.

Except for the area surrounding the Island of Gotland and a large bank to the south, both of which have large areas of stone or gravel, and sand on the bottom, the

central Baltic region has bottom sediments of mud, sand, or mud-and-sand. Depths are generally about 50 fathoms or less with some deeper holes approaching a hundred fathoms. Along the north shores of Germany and Poland the bottom sediments are predominately sand at depths to about 20 fathoms. The bottom sediments in the Bay of Danzig are mud at depths to 50 fathoms with a thin sandy bottom band along the outer spit. Along the shores of the Baltic Sea north of the Bay of Danzig sandy bottom is found along with extensive patches of gravel and stony bottom. Similar bottom sediments are found around the islands in the Bay of Riga. Stones are reported through this section. Mud-and-sand is found in the entrance to the Bay of Riga. Depths generally are of the order of twenty fathoms in these regions with fairly smooth bottoms. Sediments at the entrance to the Gulf of Finland consist of stony bottom or rock around the coast and mud in the central area with depths of about 40 fathoms. Off the southwestern coast of Finland there are many small islands which partially block the entrance to the Gulf of Bothnia. Stony and rocky bottoms are present around the islands. Mud bottoms at depths of 10 to 20 fathoms are present west of the islands in the entrance channel to the Gulf of Bothnia. Southwest of the entrance area to the Gulf of Bothnia there are mud-and-sand sediments along the coast of Sweden with stony bottoms further south. The Island of Öland is surrounded by a stony bottom. The southern coast of Sweden has sandy and stony sediments nearshore and mud-and-sand or mud offshore at depths to 40 fathoms.

4. Gulf of Bothnia.

The area between the Middle Baltic Sea and the Gulf of Bothnia is cluttered with many islands. Depths are very irregular and bottom sediments vary from stony bottoms around the islands to silt or mud in the main entrance channel. The Gulf of Bothnia is divided into two nearly equal basins by a group of islands. The dominant type of bottom sediment in the central gulf areas is mud at depths of about 50 fathoms. The shores are extremely irregular in topography in both basins with many indentations and small islands where the bottom sediments consist of gravel, coarse sand, and stony bottom. The narrow middle section of the Gulf of Bothnia has bottom sediments of sand and rock with depths mostly less than 20 fathoms.

5. Gulf of Finland.

The Gulf of Finland is a long and relatively narrow basin with a few islands and a fairly smooth bottom. Depths average 30 to 40 fathoms in the central portion of the basin. Large areas of rock bottom are present off the northern coast and in the central and western sections of the Gulf of Finland. Mud bottom is dominant in the deeper areas of the Gulf of Finland from the Baltic Sea entrance to the central rocky area, while sand is the principal bottom sediment off the southwestern coast.

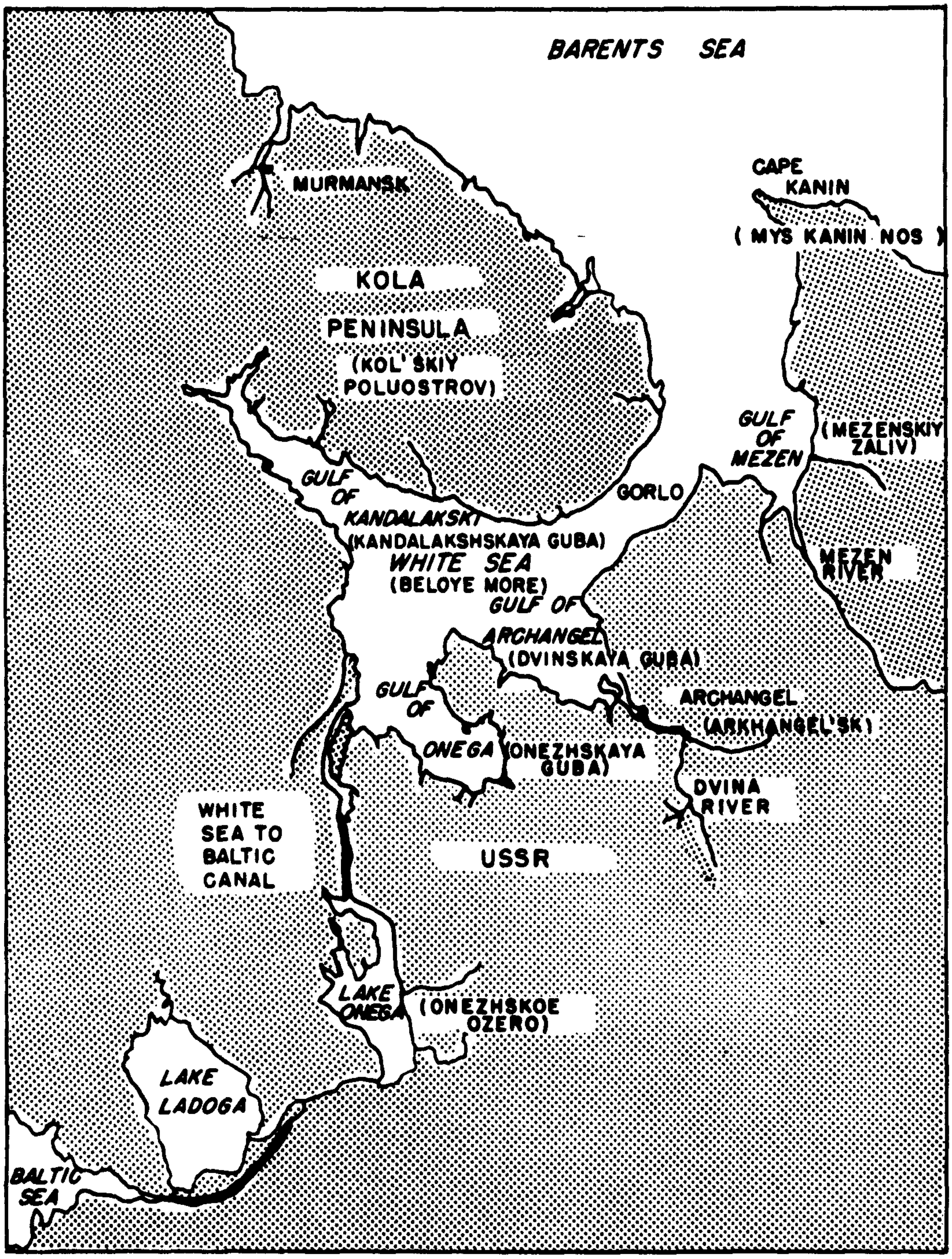

FIG. 4
WHITE SEA AREA
CANALS

V. Bottom Sediment Survey of the White Sea Area.

1. General Description of the Bottom Sediments and Topography.

The White Sea is an inland sea which penetrates far into the north European part of the U.S.S.R. It has an outlet to the north through a wide, shallow strait to the Barents Sea and an outlet to the south to the Baltic Sea via the Baltic-White Sea Canal. The White Sea area may be divided into six fairly distinct parts for descriptive purposes as follows: (Europeanized names for the White Sea area are used in this discussion since most of the available bottom sediment charts were made on old style base maps. The native names are recommended by many eminent geographers and oceanographers and are currently used by chart and map makers, including the Hydrographic Office. The native names are given in parentheses on the chart of the White Sea Area in Figure 4).

	Principal Bottom Sediments
A. Entrance to the White Sea	Sand
B. Gulf of Mezen	Sand, rock, and stones.
C. Gorlo (Strait)	Sand and rock
D. Gulf of Archangel	Mud
E. Gulf of Kandalakski	Mud or silt
F. Gulf of Onega	Stony, mud-and sand.

The White Sea is a shallow sea with depths generally under fifty fathoms except for a deep area in the Gulf of Kandalakski where there is a considerable area with depths over 100 fathoms. A long mud bank extends from the northwestern tip of the Gulf of Kandalakski through the main basin of the White Sea southeast nearly to the end of the Gulf of Archangel. Sand borders the mud bank to the northeast and stony bottom to the southwest.

2. Bottom Sediments and Topography of the Entrance Area to the White Sea.

The bottom sediments in this area are dominately sand with a few stony patches along the western coast. The water is less than 40 fathoms with a number of shoals particularly along the eastern coast.

3. Gulf of Mezen

The Gulf of Mezen is found in the southeastern part of the entrance area to the White Sea where a large indentation

of the coast marks the outlet of the Mezen River. The basin forming the Gulf of Mezen is shallow with gently sloping sandy shores. Rock bottom is present in the northern part of the Gulf of Mezen and stony bottom in the south. The bottom sediment at the outlet of the Mezen River is sand at average depths of two to three fathoms.

4. Gorlo (Strait)

This broad shallow strait leading to the White Sea is found on the western side of the Bay of Mezen. The width of the strait is about 25 to 30 miles. Average depths are about 30 fathoms with an irregular bottom and basins up to 60 fathoms. The major part of the bottom is rocky. The bottom is rocky from the Kola Peninsula coast about two-thirds of the distance across the Gorlo (Strait) with sand on the remaining bottom area.

5. Gulf of Archangel.

The extensive mud area which covers the main basin of the White Sea extends far into the Gulf of Archangel to a depth of about ten fathoms. The mud area in the Gulf of Archangel is penetrated by occasional patches of rocks. The largest rock patch is off the southern coast. Bordering the area is mud-and-sand which extends to the group of islands offshore from Archangel. Depths in the channels between these islands are small. Archangel is found beyond the channels on the banks of the River Dvina at the point where it empties into the Gulf of Archangel.

6. Gulf of Kandalakski.

The greatest depths in the White Sea area are to be found in the Gulf of Kandalakski, the maximum being about 160 fathoms. The bottom sediments for the entire Kandalakski Gulf consist of silt or mud except for one small area of mud-and-sand off the western coast.

7. Gulf of Onega.

The Gulf of Onega has stony bottom along the western and southwestern parts and mud-and-sand in the east and southeast with some rocky and sandy patches. The water depths in the Gulf of Onega are less than ten fathoms with many banks and shoals except in the central portion where depths are found up to 30 fathoms. The shore line around the Gulf of Onega is irregular with many inlets. The outlet of the canal from the Baltic Sea to the White Sea is found along the west coast of the Gulf of Onega.

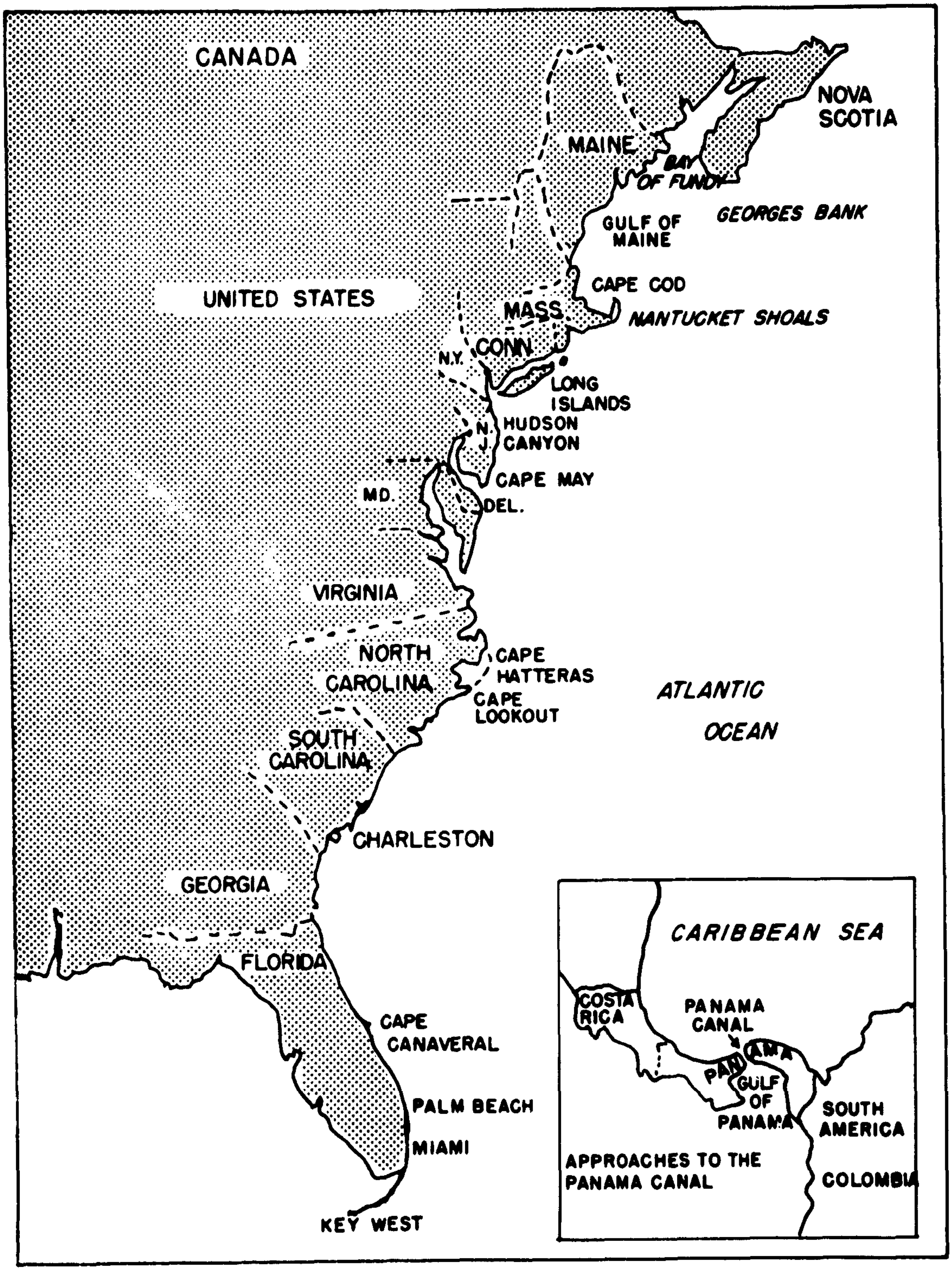

FIG. 5

UNITED STATES EAST COAST AREA
AND APPROACHES TO THE PANAMA CANAL

VI. Bottom Sediment Survey of the United States East Coast and the Approaches to the Panama Canal.

1. General Description of the Area.

The continental shelf bottom sediments off the east coast of the United States are glaciated gravel and rocky bottom in the Gulf of Maine, sandy sediments from the approaches to New York to Cape Hatteras, sand and shells from Cape Hatteras to Cape Canaveral, and coral off Key West, Florida. Mud is found in the inlets and estuaries. The continental shelf is very narrow at Cape Hatteras and Palm Beach. Depths over the continental shelf are less than fifty fathoms except in the Gulf of Maine where depths over 100 fathoms are common.

2. Bay of Fundy to Cape Cod.

Bottom sediments around the entrance to the Bay of Fundy are stony or rocky probably due to the great tidal currents. Along the coast of the Gulf of Maine the bottom is rocky in a narrow band nearshore. Outside this rocky band the bottom deposits are primarily soft mud with some scattered stony or rocky patches at depths up to 120 fathoms. The edge of the rocky band coincides very closely with the fifty fathoms line. The stony patches in the Gulf of Maine are on banks with depths about 40 to 60 fathoms. The bottom surrounding Cape Cod is sandy. Some mud is found inside the cape.

3. Georges Bank and Nantucket Shoals.

Across the Gulf of Maine on the seaward side the sediments are coarser with extensive patches of mud-and-sand, sand, and stony bottom covering Georges Bank at depths of less than ten fathoms. From Georges Bank sandy bottom extends out to the edge of the continental shelf where the sand gives way to mud and silt. The continental shelf makes a wide sweep in toward the coast south of Georges Bank. Many submarine canyons have been charted along the southern edge of the continental shelf. They extend into the continental shelf from 5 to 12 miles and are from two to six miles in width. A wide sandy bottom extends into the shore around both sides of Nantucket Island, Martha's Vineyard Island, and into Nantucket Sound from Georges Bank. Offshore from Nantucket Island there are many shoals with depths as shallow as two to three fathoms. Seaward the depths increase to 30 to 40 fathoms, then decrease again at Little Georges Bank. South of the sandy bottom at Cape Cod, the sediments are sand-and-mud or mud.

4. Approaches to New York (Nantucket Shoals to Five Fathom Bank).

The bottom sediment on the continental shelf of the approaches to New York consists entirely of sand. It differs radically from the patchy sediments to the north. The topography differs in that there are no prominent banks offshore, but there are many small hills and valleys present. A prominent feature of the bottom topography of this area is the famous Hudson Canyon which is found off the mouth of the Hudson River. This canyon extends 17 miles inside the hundred-fathom line, has a maximum depth below adjacent ridges of 4,000 feet, a maximum width of 8 miles and has been charted for a distance of more than fifty miles. A finer sediment or silt is found on the floor of the Hudson Canyon than that which is found on the adjacent banks. The sand on both sides of the Hudson Canyon contains a mixture of shells and gravel.

5. Cape May to Cape Hatteras.

The sandy bottom sediments on the continental shelf extend southward from Cape May to Cape Hatteras. From the Chesapeake Bay entrance southward to Cape Hatteras the shelf narrows until it is only a few miles wide off Cape Hatteras. The bottom topography appears to be fairly smooth along the main portion of the continental shelf with depths between 10 and 20 fathoms. Four large submarine canyons are found in this section. They extend from 7 to 11 miles into the continental shelf with maximum widths of 4 to 7 miles and maximum depths below adjacent ridges of 2400 to 3600 feet. Along the edge of the continental shelf south of Cape May, a sand-and-mud bottom is present which extends to an area northeast of Cape Hatteras. The bottom sediments along the continental slopes and basins is mud or silt.

6. Cape Hatteras to Charleston.

South of Cape Hatteras the continental shelf is much wider. The coast-line is characterized by the capes formed by currents set up by the Gulf Stream. Depths are very shallow off the point of each of the capes. Along the coast the bottom sediments consist of sand with many shells in contrast to the area north of Cape Hatteras which contains sand with few shells. Along this section of the coast, a change in the slope of the continental shelf occurs at the 20- to 30-fathom line, but a sandy bottom extends out to the 100-fathom line. Outside the 100-fathom line, coral bottom may be found between Cape Hatteras and Cape Lookout, extending in an ever widening band.

7. Charleston Light to Cape Canaveral.

South from Charleston to Cape Canaveral the continental shelf sediments consist primarily of sand and shells. A small number of stony patches are found southeast of Charleston. Although the edge of the continental shelf reaches to depths of about 30 fathoms, sand and shell sediments extend out slightly beyond the hundred fathom line on the continental slope. Outside the sand and shell limits, coral bottom is found extensively.

8. Cape Canaveral to Key West.

South of Cape Canaveral the continental shelf narrows steadily until it is only a few miles wide at Palm Beach. The Gulf Stream sweeps along the coast of Florida at this point and carries the loose and fine sediments away. Sediments along the coast north of the Miami region are sand and shells. South of the Miami region coral bottom is found. The 100-fathom contour is near shore at Key West. The west coast of Florida has a wide continental shelf.

9 Approaches to the Panama Canal.

The bottom sediments on the Caribbeam Sea approaches to the Panama Canal are very patchy with soft mud, sand-and-mud, shells, and coral. There is a wide area of sand and shells from ten to fifteen miles offshore north of the Panama Canal entrance with a narrower prong of the sand and shell sediments extending to about five miles north of the entrance. The sand and shell sediments are bordered on both sides by an extensive area of sand-and-mud followed by mud bottom. Coral patches are scattered throughout the offshore sediments. Nearshore around the Panama Canal entrance the bottom sediment is sand-and-mud bordered on the east by large areas of coral along shore and mud offshore and on the west by sand and coral along shore and extensive mud bottom offshore. Depths increase gradually from about six fathoms near the Panama Canal entrance to about forty fathoms at the continental shelf edge about ten miles offshore. Depths on the continental slope increase rapidly to several hundred fathoms.

On the Pacific Ocean side of the Panama Canal, in the Gulf of Panama, most of the bottom sediments nearshore appear to be soft mud with a few rock patches near the Panama Canal entrance and sand out near the Gulf of Panama entrance. Offshore the principal bottom sediment is sand out to the edge of the continental shelf. There are small coral and rock patches around a small island and shoal area near the center of the Gulf of Panama. Depths range from eight fathoms at the Panama Canal entrance to about fifty fathoms at the edge of the continental shelf.

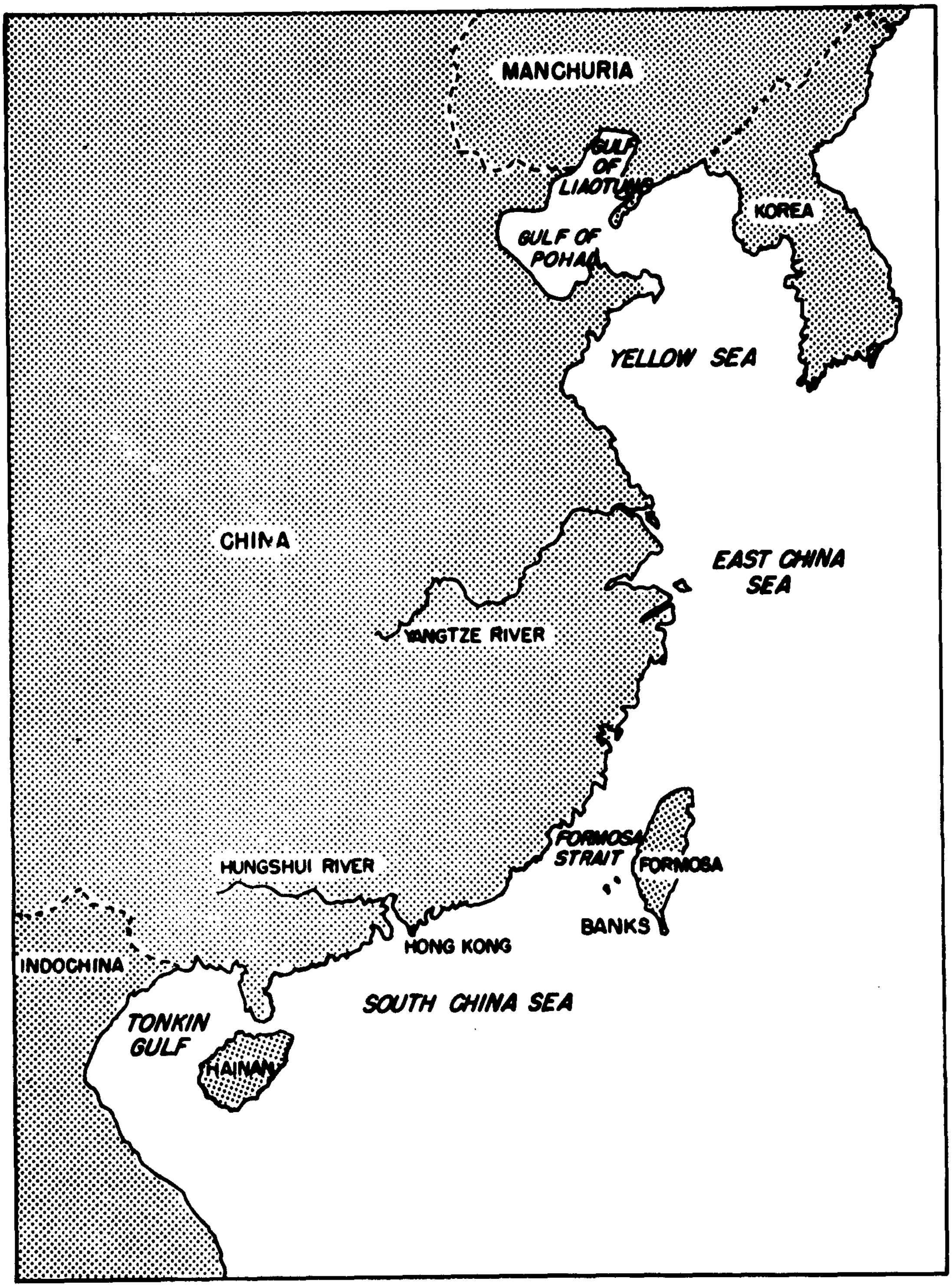

FIG. 6
YELLOW AND CHINA SEA AREA

VII. Bottom Sediment Survey of the Yellow and China Seas Area.

1. General Description of the Area.

The continental shelf in the Yellow and China Seas area is noted for its extensive width. Depths over most of the continental shelf area are usually less than 50 fathoms, and the topography is smooth with few outstanding irregularities. The coast line of China is rough with many small bays and inlets whose bottoms are covered by mud. A narrow mud belt is found along most of the Chinese coast. Outside the narrow mud belt a wide expanse of sandy bottom is found covering most of the wide continental shelf area.

2. Northern Part of Yellow Sea with Gulfs of Pohai and Liaotung.

The bottom sediments in the Gulf of Pohai Strait are primarily muddy in character with large patches of sand-and-mud and a few scattered patches of hard sand, rock, or stony bottom. The bottom topography of this area is essentially shallow and smooth with few depths greater than 20 fathoms and many 12 to 14 fathom depths recorded. In the northern part of the wide Strait of Pohai which connects the Gulf of Pohai with the northern Yellow Sea, depths of thirty to forty fathoms are found. Bottom sediments in the Strait of Pohai are patchy with stony and sandy bottom to the north and muddy bottom to the south. In the northern part of the Yellow Sea, the bottom sediments along the western coast of Korea are firm sands while in the northeastern part of the Yellow Sea, and off central western Korea, the bottom sediments are principally soft mud. Depths vary from 20 to 40 fathoms over most of what appears to be a smooth bottom. While many scattered rocky and muddy patches are found along the southwestern coast of Korea, the principal bottom sediment is sand.

3. Southern Part of the Yellow Sea.

The Yellow Sea is shallow with few places greater than 50 fathoms. Bottom sediments in the central part of the Yellow Sea are mud or mud-and-sand. Extensive areas of sandy bottom are found in the shallow waters along the coast of China and in the deeper basins (50 to 70 fathoms) off the south coast of Korea. Rocky bottoms are found along the southwest coast of Korea.

4. East China Sea and Area around Formosa.

Mud bottom is found in the East China Sea along the coast of China from the mouth of the Yangtze River to Formose Strait. Outside the wide mud bottom area along the coast, firm sandy bottom extends far out to form one of the widest continental shelf areas of the world. The

bottom topography is relatively smooth with few irregularities and the depths are less than fifty fathoms. The continental shelf narrows in the southern part of the East China Sea. Approaching the island of Formosa the shelf becomes very narrow on the east side of the island where the 100-fathom line is close to shore. Sediments along the east coast of Formosa are patchy with rocky bottom, sand and mud. Bottom sediments in the Strait of Formosa consist of sand along the coast of Formosa and mud along the irregular coast of China with its many bays and inlets. Off the west coast of Formosa, a small group of islands have rocky and stony bottoms. The Formosa Banks which are located southwest of the island group have sandy sediments with depths as small as 5 fathoms. Greater depths prevail between the Formosa Banks and the China coast. In general, depths through the Formosa Strait vary from 20 to 40 fathoms.

5. South China Sea Area.

The large area of sandy bottom offshore from the coast of China extends southward through Formosa Strait, over the Formosa Banks and southwest to a region offshore from Hong Kong where it terminates in soft mud bottom. Inshore along the irregular Chinese coast the bottom sediment is mud with occasional patches of rocky or stony bottoms. In the area offshore from Hong Kong, the mud bottom becomes more prevalent although large patches of sand, sand-and-mud, stony, and rocky bottom may be found. The bottom sediments around Hainan Island and in Tonkin Gulf are mud with small patches of sand, stony, and rocky bottom along the shores. Depths of the water on the continental shelf area from Formosa to the southern part of Hainan Island, including the Tonkin Gulf, are in the range of 30 to 50 fathoms with the edge of the continental shelf at depths of about 60 fathoms. South of Hainan Island, along the coast of French Indochina, the continental shelf becomes very narrow. The bottom sediments are dominantly mud with patches of sand, stony, and rocky bottom. A number of islands are found further offshore in the South China Sea with surrounding banks or reefs of coral.

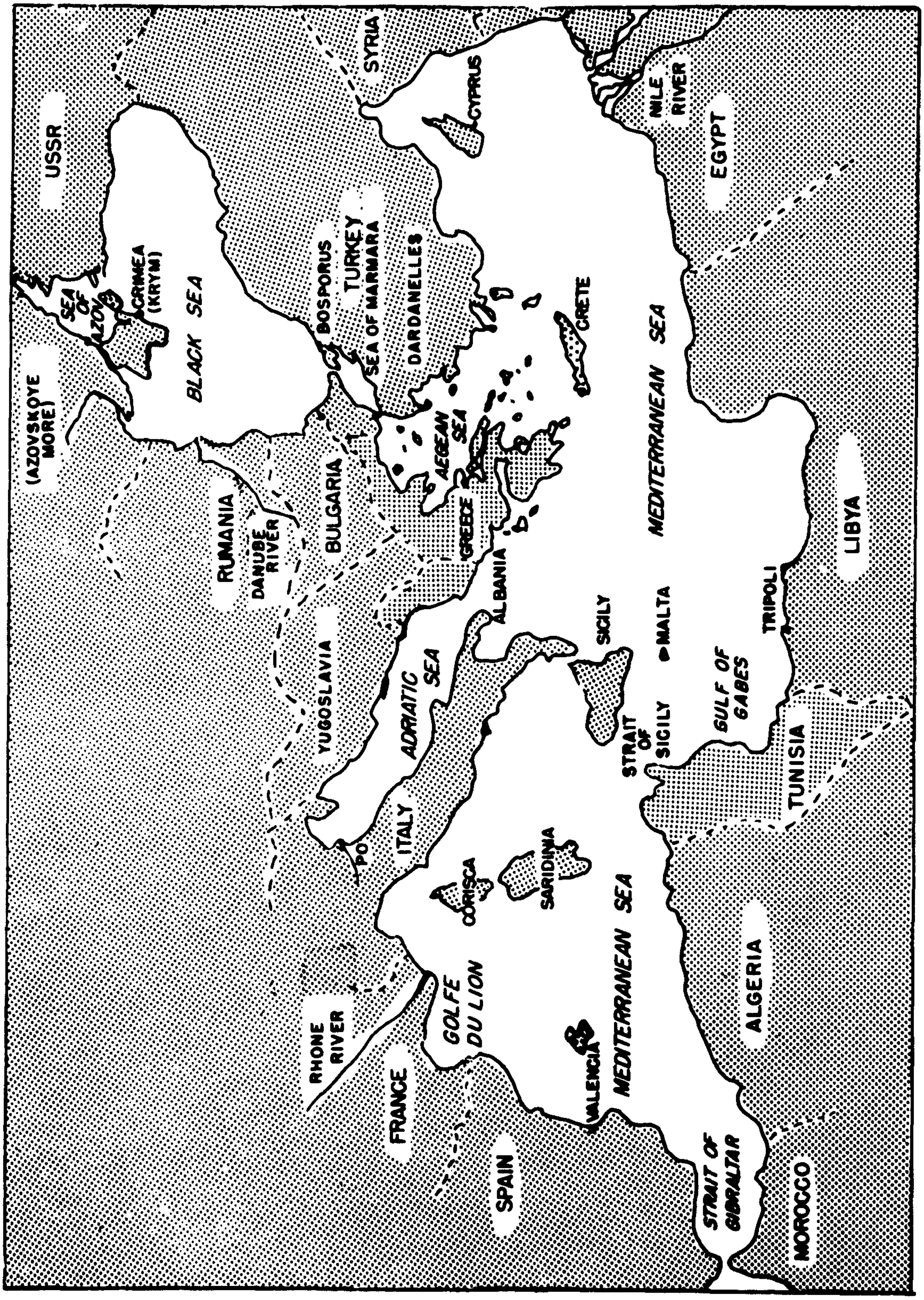

FIG. 7
MEDITERRANEAN SEA AREA

VIII. Bottom Sediment Survey of the Mediterranean Sea Area.

1. General Description of the Area.

The Mediterranean Sea has a long, irregular shape which is naturally divided near the middle at the Strait of Sicily by Italy, Sicily, and the northern part of Tunisia. For the purposes of this discussion, the Adriatic Sea area and the Black Sea area are considered as natural divisions of the Mediterranean Sea area. Much of the continental shelf area around the Mediterranean Sea is narrow but occasional wide shelves are found. Many of the continental shelf areas have sandy or rocky bottom along shore with mud sediments offshore. Sediments around the capes or points of land usually consist of sand or rocks, while mud or mud-and-sand is often found in the bays and around the river deltas. Small patches of coral occur throughout most of the Mediterranean Sea continental shelf area. The extensive continental shelf area in the Adriatic Sea is dominantly muddy in character except for the sandy patches in the northern part, and the shelf sediments in the Black Sea area consist principally of mud or mud-and-sand. Although not as extensive in area as the mud and sand deposits, rocky patches are found throughout the Mediterranean Sea continental shelf area.

2. Western Mediterranean Sea Area.

The area considered here as the Western Mediterranean Sea area is that area bounded by the Strait of Gibraltar on the west and the Strait of Sicily on the east. Beginning at the south side of the Strait of Gibraltar, the narrow continental shelf is rocky, due to currents sweeping the loose sediments away. Depths in the nearly ten-mile wide Strait of Gibraltar are 200 to 300 fathoms with bottom sediments of sand, gravel and rock. The continental shelf area is very narrow along the coast of Morocco and Algeria with depths of 20 to 50 fathoms. Patches of rocky bottom, sand and coarse gravel are found intermittently along the north coast of Africa particularly around the points of land. The dominant bottom sediment is mud which is found with the rocky or sandy patches nearshore and offshore. Mud covers the bottom of the small bays along this section of coast. Some coral patches are found off the coast of Tunisia. The continental shelf is more extensive along the north shores of Tunisia with widths of ten to twenty miles. At the Strait of Sicily, the Continental shelf extends across the Mediterranean Sea with depths up to about 200 fathoms and bottom sediments of mud and sand with some rocky areas. The narrow continental shelf off the north coast of Sicily has bottom sediments of mud and sand

with rocky patches. The Strait of Messina between Sicily and Italy is only a few miles wide with depths of 60 to 100 fathoms and coarse sand, gravel or rocky bottom. The continental shelf from the Strait of Messina up the Italian coast is narrow with mud and sand sediments. A small amount of rocky bottom is found along the points of land with sand nearshore and mud offshore. This type of bottom sediment pattern and continental shelf continues along the western coast of Italy past the French border to the vicinity of the Rhone River where the continental shelf is wider. The principal bottom sediment is mud with some sand in the Golfe du Lion. In this area much of the continental shelf area is about 50 fathoms deep. The continental shelf narrows along the Mediterranean coast of Spain except in the region of Valencia with an extensive area of mud at depths of about 50 fathoms. The north coast of the Strait of Gibraltar has bottom sediments of coarse sand and gravel with rocky bottom nearshore.

3. Adriatic Sea Area

The Adriatic Sea area is a long narrow basin with depths up to 130 fathoms, and an extensive continental shelf area extending from the Gulf of Venice some 240 miles southward. Around the shores of the northern end of the Adriatic Sea there is a narrow band of mud nearshore followed by an extensive sandy bottom enclosing a large area of mud at depths of 25 fathoms. The area off the River Po is a few feet deep with sand directly offshore and extensive mud deposits to the south at depths of less than 10 fathoms. Bottom sediments for the remainder of the Adriatic basin are dominantly mud with fringes of sandy and rocky bottom and spots of coral. Numerous islands are found off the coast of Yugoslavia. Near the southwest coast of the Adriatic Sea, not far from the mouth, depths of several hundred fathoms are found a short distance from shore with mud as the dominant sediment.

4. The Eastern Mediterranean Sea Area.

The Eastern Mediterranean Sea area is here considered to extend from the Strait of Sicily to the shores of Syria without including either the Adriatic Sea or the Black Sea. Off the eastern coast of Tunisia, south of the Strait of Sicily, the continental shelf widens with a mud and sand bottom. The width increases to a maximum of 180 miles at the Gulf of Gabes with a sandy bottom. The continental shelf narrows at Tripoli and averages a width of about 20 miles, west to the Nile River. The bottom sediments along this coast are sand with occasional patches of rock. The bottom sediments west of the Nile delta are rocky bottom nearshore and sand offshore. The Nile delta bulges out into the Mediterranean Sea and the continental shelf area makes a similar bulge with bottom sediments of mud and occasional patches of sand. East of the Nile delta, the bottom sediments are mud with sand and rock patches along the coast.

The continental shelf narrows along the coast of Syria and the Turkish Mediterranean coast. Sediments are patchy with mud or mud-and-sand in the bays, with rock or sand around the points of land. Detailed bottom sediment charts are not yet available for some of this area. Offshore around the Dardanelles there is some stony bottom with sand inshore. The Aegean Sea and the area around the coast of Greece has a large number of islands which complicates the bottom sediment distribution. A publication of the Hydrographic Office discusses the bottom sediment distribution and the oceanographic factors of the Aegean Sea area in great detail[1]. Around the east coast of Sicily the shelf is narrow but it widens to the south to include the island of Malta and an extensive shelf area east of Malta. Sediments consist mostly of mud or sand with numerous rocky patches.

5. The Black Sea Area.

The entrance to the Black Sea area from the Mediterranean Sea is through the Dardanelles, the Sea of Marmara, and the Bosporus. Bottom sediments are mud or mud-and-sand and a few rocky patches with maximum depths of 30 to 40 fathoms in the Dardanelles. Sediments in the Sea of Marmara consist of mud or mud-and-sand with some rocky patches. There is a small shelf area in the northern part of this sea and a much larger shelf area in the south with deep water in the middle portion. On the Marmara approaches to the Bosporus the main bottom sediment is sand, while in the Bosporus sand, gravel and stones are to be found with depths of 20 to 40 fathoms. North of the Bosporus, in the Black Sea, there is a shelf area with sandy sediments along shore in a band of varying width. The offshore sediments are sand-and-mud or mud. This type of sediment extends to the area around the Danube River mouth where the shelf widens to a maximum of 120 miles with depths of less than 50 fathoms and extensive bands of sandy bottom nearshore and mud with various mixtures of sand offshore. Numerous quantities of shell are found mixed with the bottom sediments off the delta of the Danube. The shelf narrows to the east of the Danube delta to about ten to fifteen miles off southwestern Crimea. Depths in this area drop off nearshore to about 40 fathoms and gradually slope to about 60 fathoms at the edge of the shelf. Soft mud bottom sediments are present over the entire shelf area. The shelf area of the remainder of the Black Sea is quite narrow with sediments of mud and mud-and-sand and with numerous rocky patches.

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1. Oceanographic Study of the Aegean Sea, U. S. Navy Hydrographic Office Publication No. 753, 1947. Confidential.

IX. Conclusion

The U. S. Navy Hydrographic Office has published over a hundred bottom sediment charts and is continuing to publish them at a rate of about fifteen a year. The U. S. Coast and Geodetic Survey has gathered bottom sediment information for many years and has published bottom sediment charts for the United States and possessions. In addition, the U. S. Navy Hydrographic Office is covering certain harbors in great detail with their Inshore Survey program and their Hydrographic Oceanographic Data Sheets (HODS). The reliability of this data on bottom sediments is considered as very good. The bottom sediment charts are based on thousands of observations which have been interpreted by trained geologists. However it must always be remembered that bottom sediment locations are subject to constant change due to storms, high wave and swell action, and varying bottom currents. Also nearly all of the older bottom sediment data was based on lead line, tallow, or shallow scoop observations which may represent only a thin covering over the deeper bottom sediments. Information about a vertical distribution of bottom sediments in shallow water areas is particularly scarce. The measurements available from coring data indicate that many areas have a very complex strata of bottom sediments. Samples taken from the surface of the ocean bottom with a piece of tallow or a shallow scoop fails to provide sufficient information on bottom sediments for many purposes, particularly on whether a given type of weapon would penetrate the bottom or not. The scarcity of information on the vertical distribution of bottom sediments is probably due partly to the technical difficulty of coring operations, partly to the enormous amount of work which would be required to do an adequate job and partly to the fact that there was no urgent need for such data in the past. Dr. Willis Tressler of the Inshore Survey Branch of the Navy Hydrographic Office in a verbal communication expressed the opinion that improved coring instrumentation is badly needed. Apparatus which would allow a ship under way to take frequent core samples several feet in length would greatly simplify the problem of obtaining needed data on the vertical distribution of sediments.

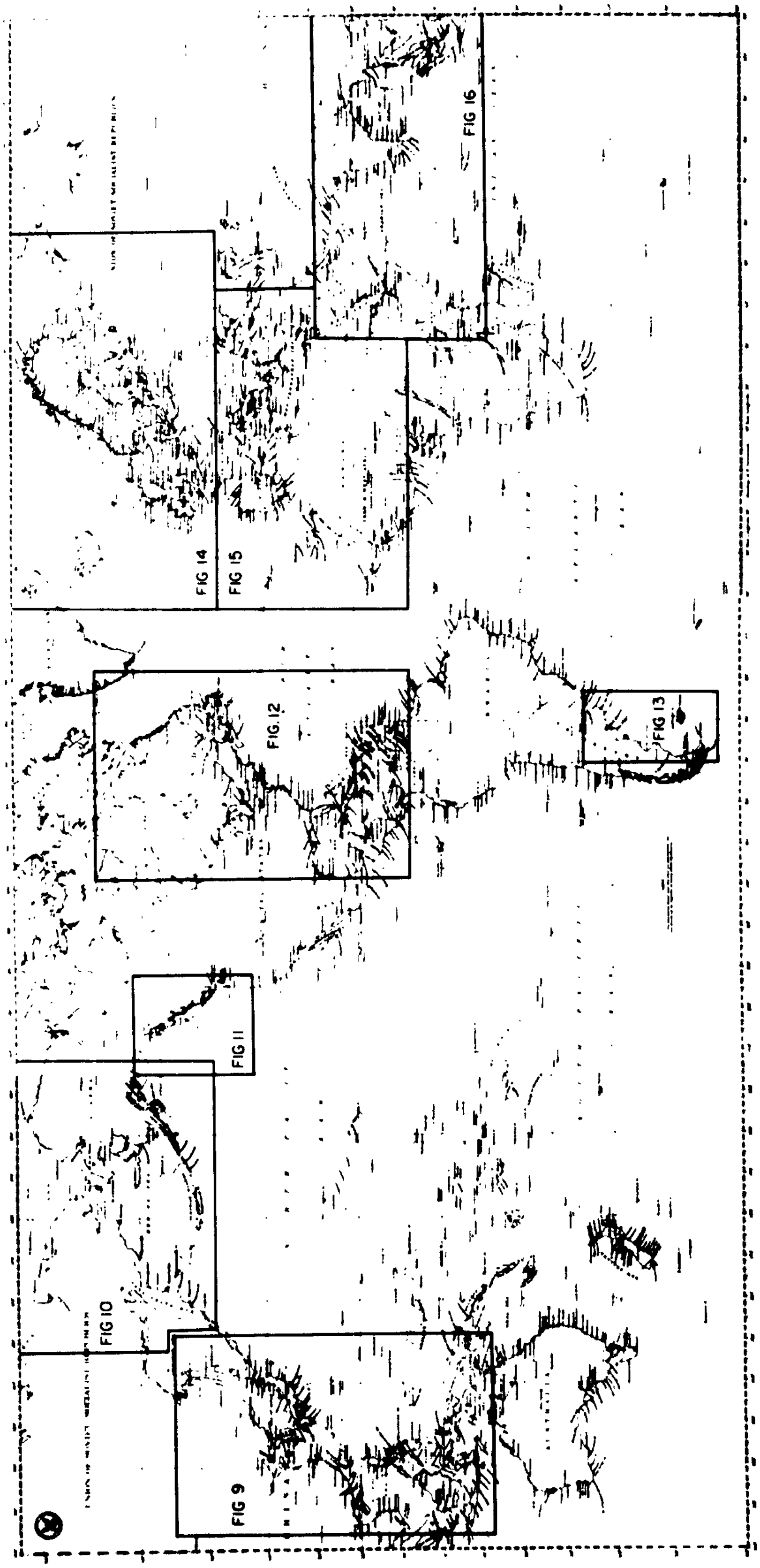
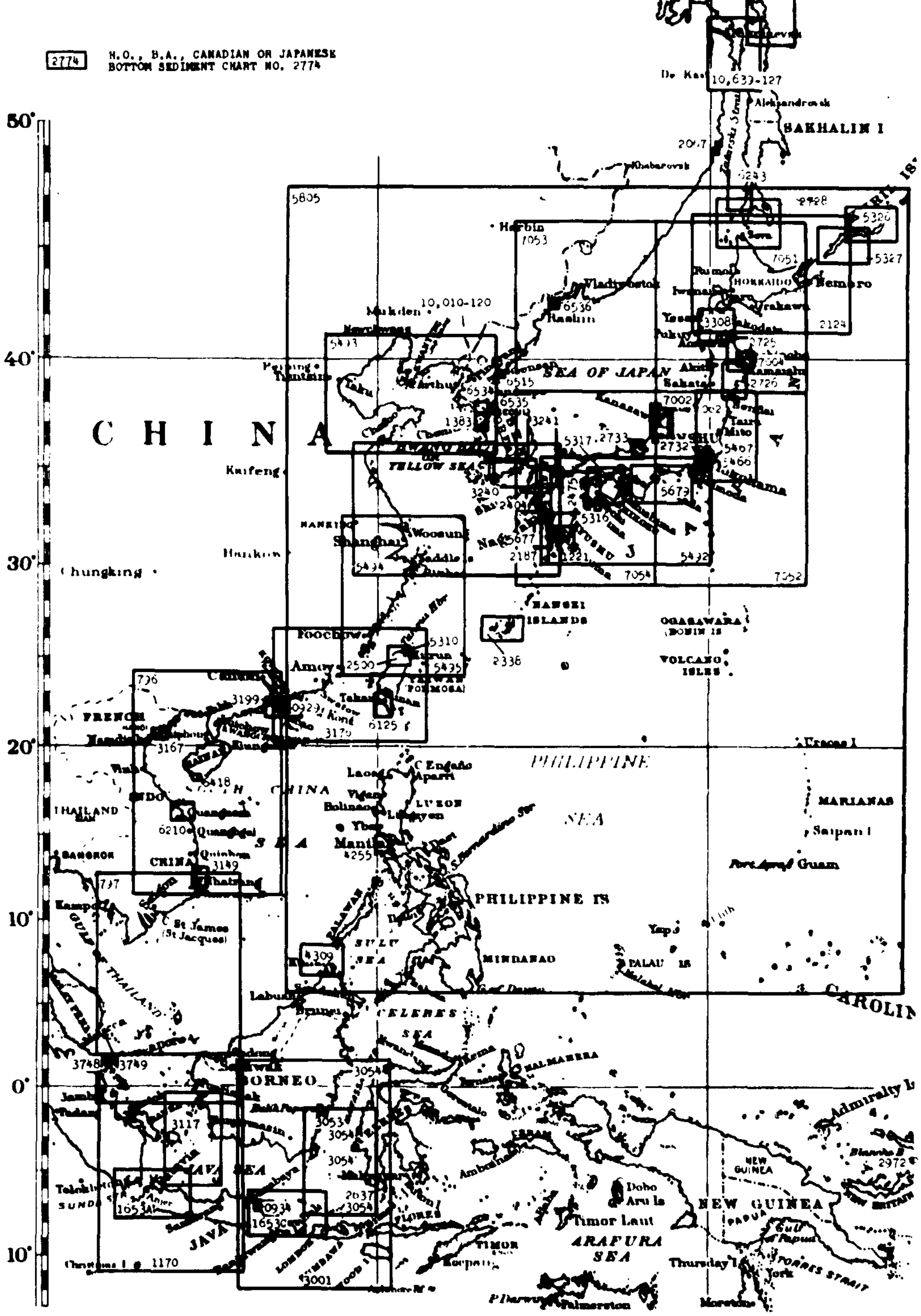


FIG. 8

BOTTOM SEDIMENT CHART AREAS DETAILED IN FIGURES (AS INDICATED) IN THIS REPORT

FIG. 9

ALL CHARTS COMPILED BY J.J. MALLOY, HYDROGRAPHIC OFFICE, JULY 1951-JULY 1952. ADDITIONAL CHARTS THROUGH OCTOBER 1952 ADDED BY H.O. DORSETT.



SECURITY
INFORMATION

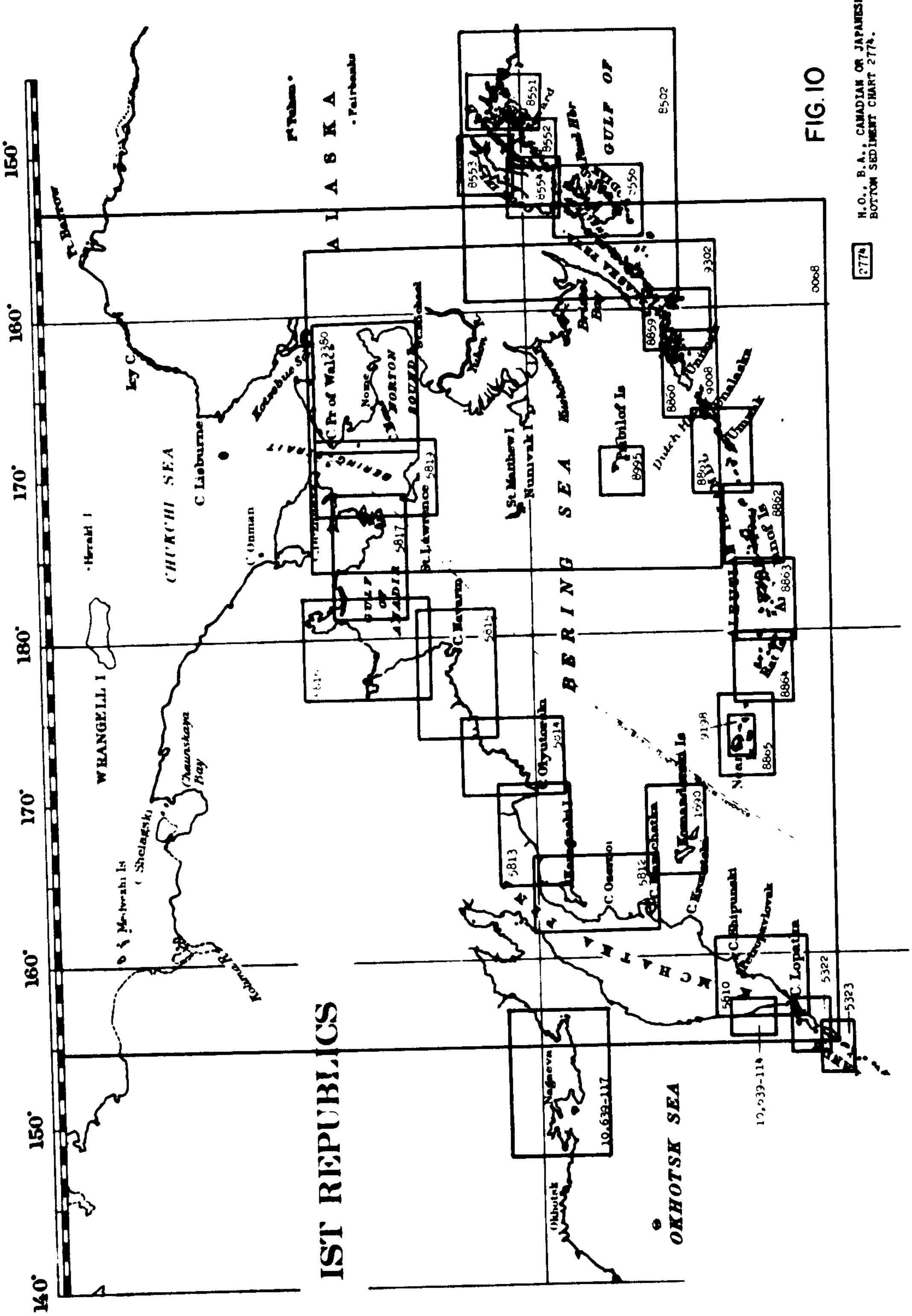


FIG.10

2774 H.O., B.A., CANADIAN OR JAPANESE BOTTOM SEDIMENT CHART 2774.

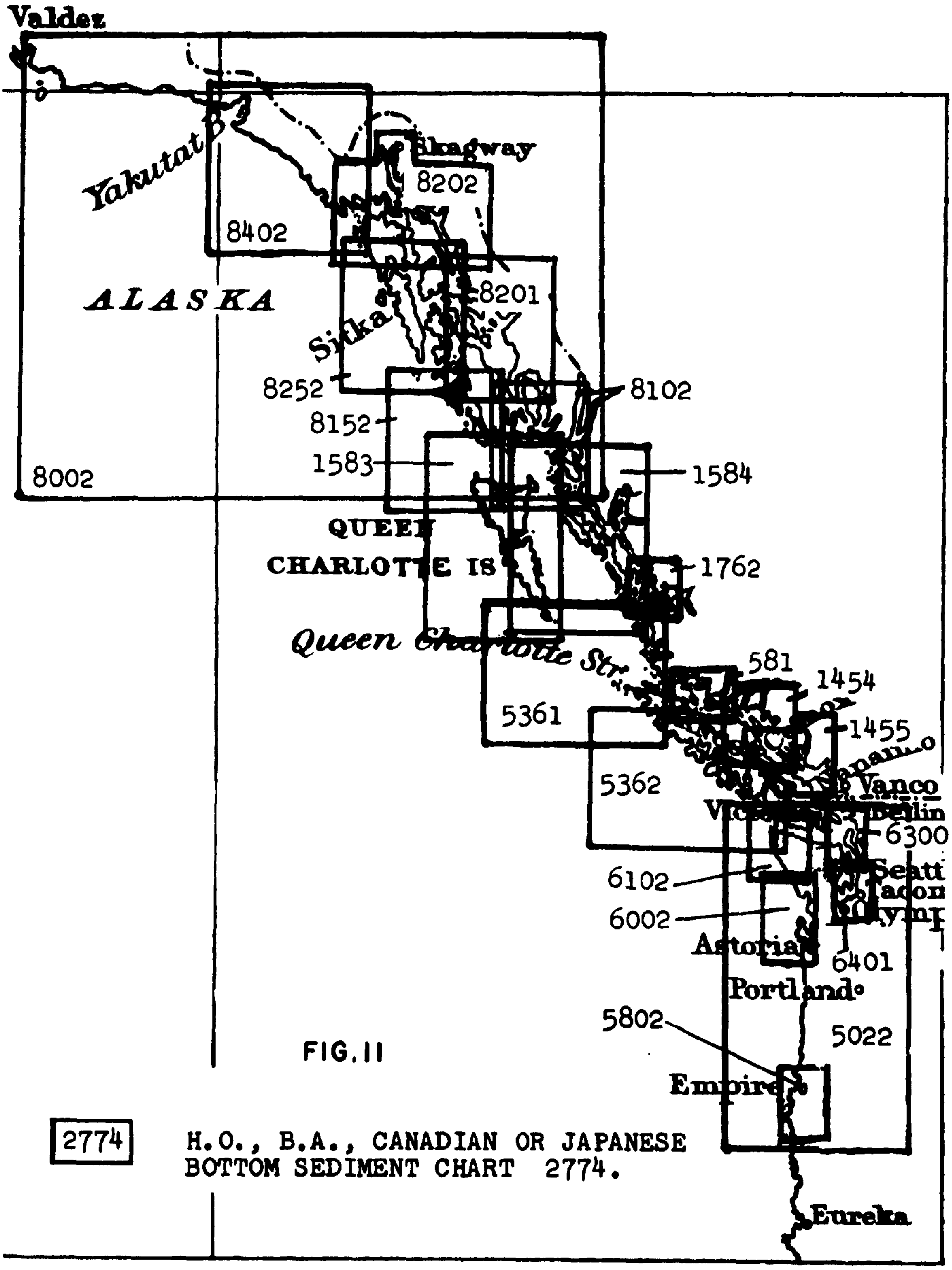

Valdez
Yakutat
Skagway
8202
8402
ALASKA
8201
Sitka
8252
8152
1583
8002
8102
1584
QUEEN
CHARLOTTE IS
1762
Queen Charlotte Str.
581
1454
1455
5361
5362
6300
6102
6002
Astoria
6401
Portland
5802
5022
Empire
Eureka
2774
H.O., B.A., CANADIAN OR JAPANESE
BOTTOM SEDIMENT CHART 2774.

FIG. 11

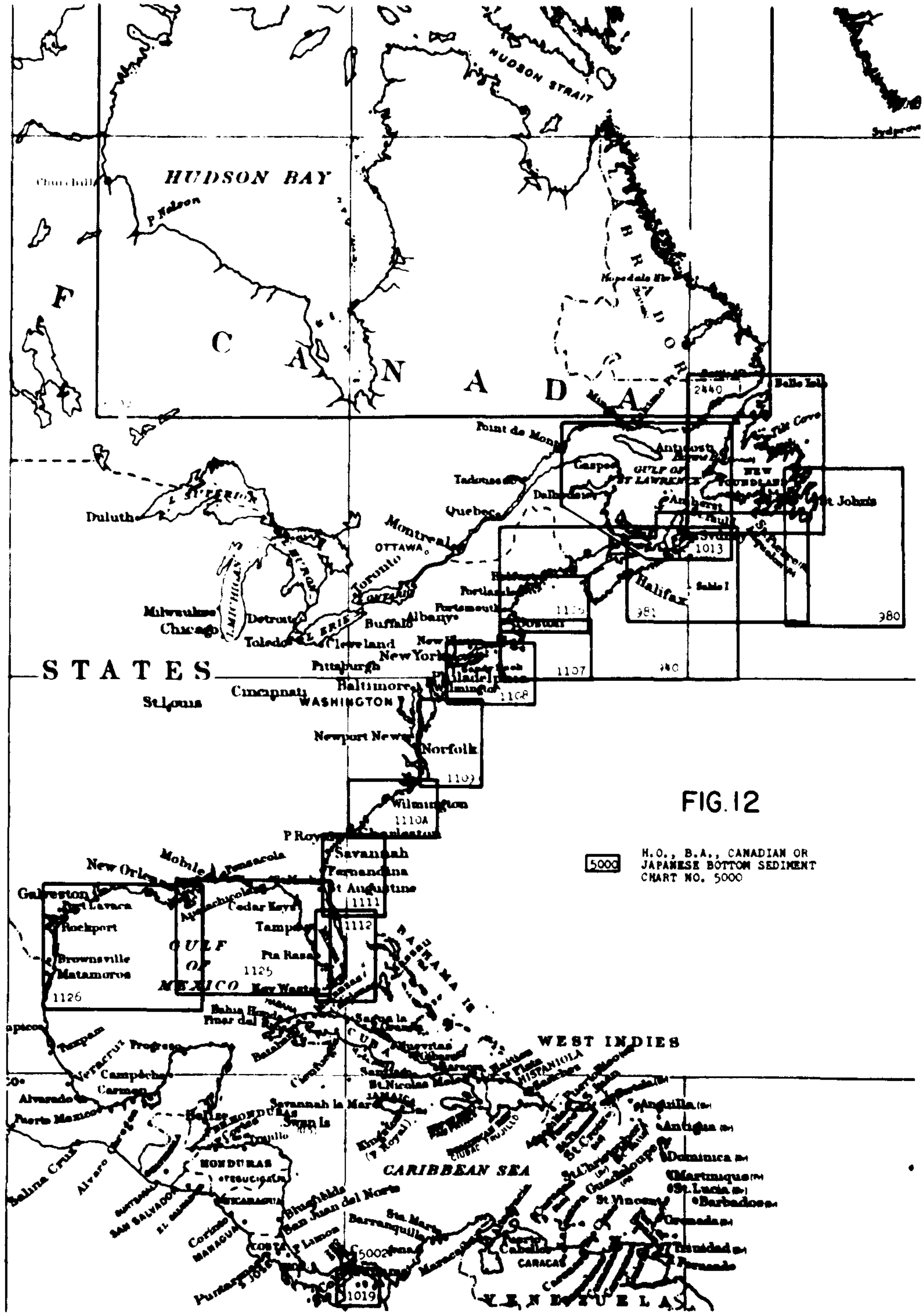


FIG. 12

5000 H.O., B.A., CANADIAN OR JAPANESE BOTTOM SEDIMENT CHART NO. 5000

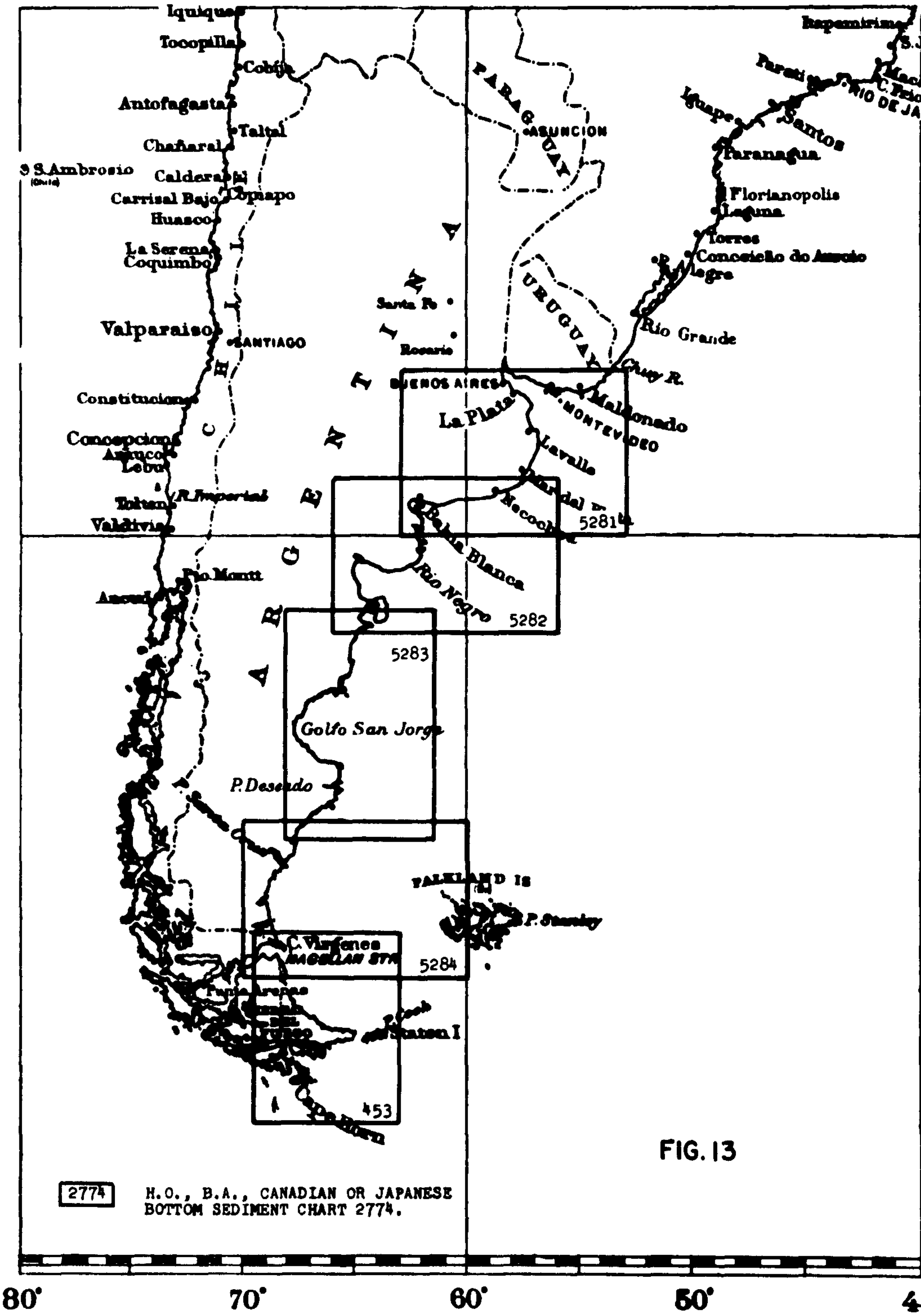

Iquique
Tocopilla
Cobija
Antofagasta
Taltal
Chañaral
S.Ambrosio
Caldera
Carrisal Bajo
Copiapo
Huasco
La Serena
Coquimbo
Valparaiso
SANTIAGO
Constitucion
Concepcion
Arauco
Lebu
Tolten
R.Imperial
Valdivia
Pto.Montt
Ancud
C H I L E
A R G E N T I N A
PARAGUAY
ASUNCION
URUGUAY
Santa Fe
Rosario
BUENOS AIRES
La Plata
MONTEVIDEO
Maldonado
Lavalle
Mar del Pl.
Necochea
Bahia Blanca
Rio Negro
Golfo San Jorge
P.Deseado
FALKLAND IS
P. Stanley
C.Virgenes
MAGELLAN STR
Punta Arenas
Staten I
Itapemirim
Paraty
RIO DE JA
Santos
Iguape
Paranagua
Florianopolis
Laguna
Torres
Conceição do Arroio
P. Alegre
Rio Grande
Chuy R.
5281
5282
5283
5284
453
2774
H.O., B.A., CANADIAN OR JAPANESE BOTTOM SEDIMENT CHART 2774.
80°
70°
60°
50°
40°

FIG. 13

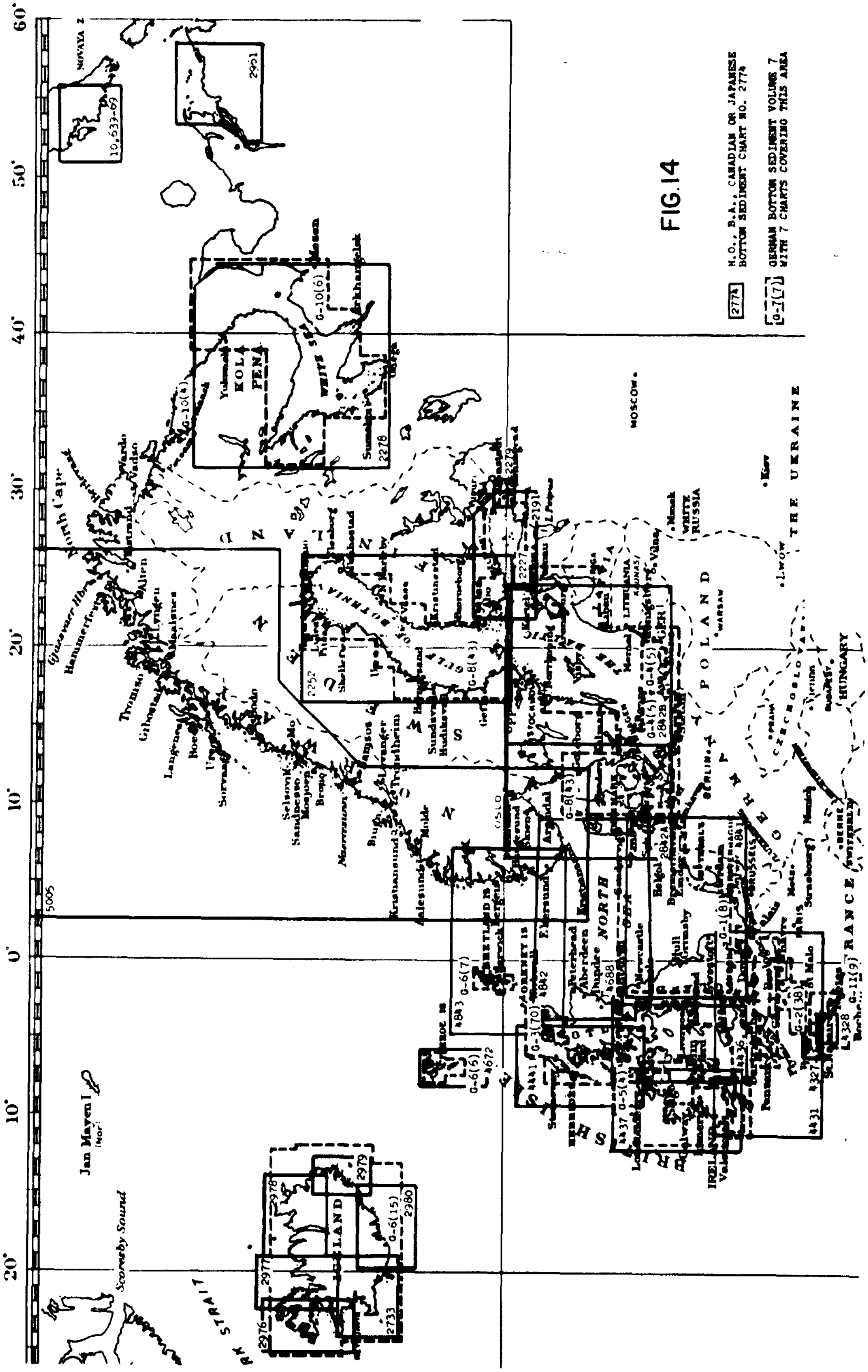

2774 H.O., B.A., CANADIAN OR JAPANESE BOTTOM SEDIMENT CHART NO. 2774
G-7(7) GERMAN BOTTOM SEDIMENT VOLUME 7 WITH 7 CHARTS COVERING THIS AREA
NORTH SEA
POLAND
THE UKRAINE
HUNGARY
FRANCE
MOSCOW
KOLA PENA.
WHITE SEA
Jan Mayen I.
Scoresby Sound
North Cape

FIG. 14

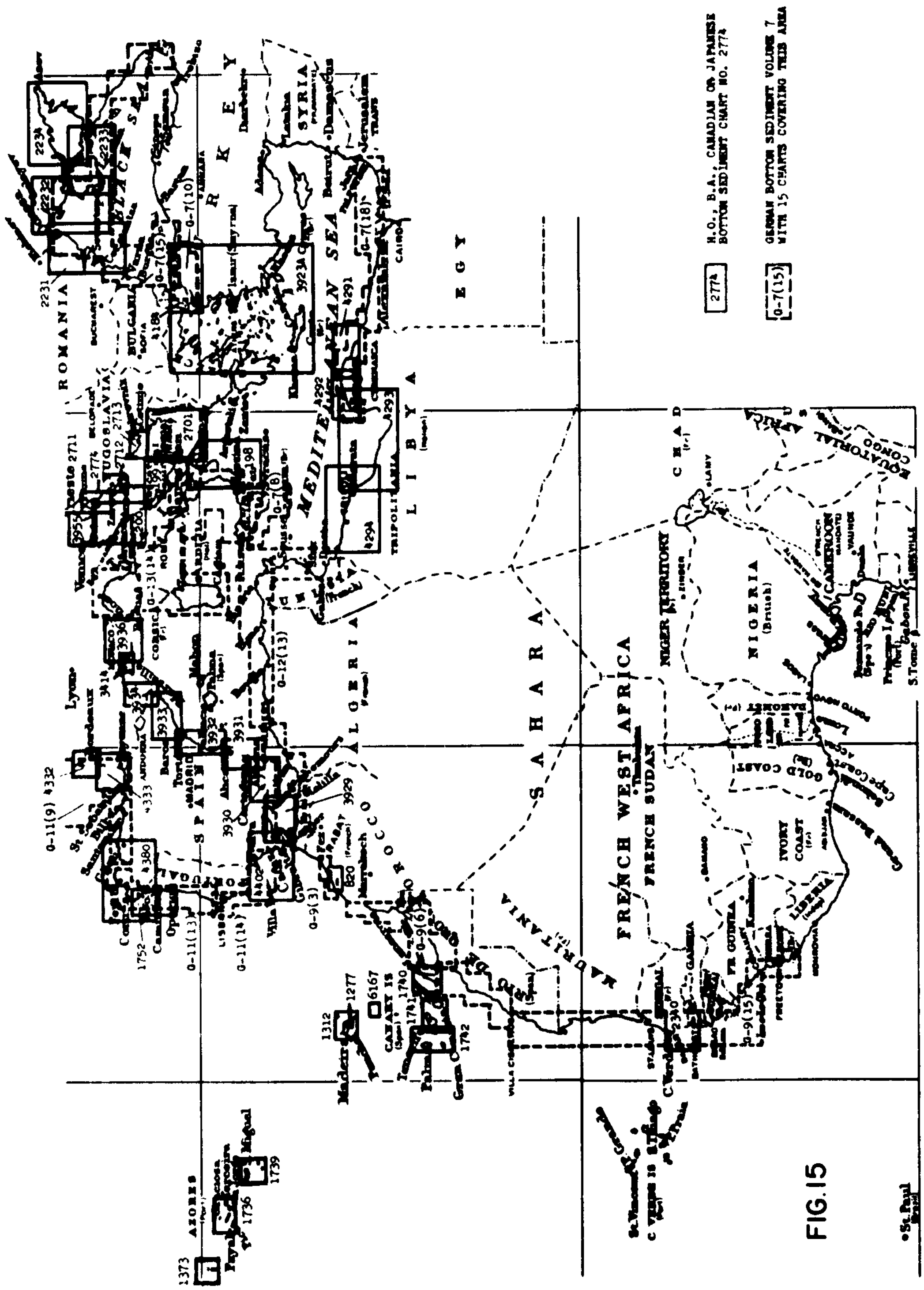

2774 H.O., B.A., CANADIAN OR JAPANESE BOTTOM SEDIMENT CHART NO. 2774
0-7(15) GERMAN BOTTOM SEDIMENT VOLUME 7 WITH 15 CHARTS COVERING THIS AREA

FIG. 15

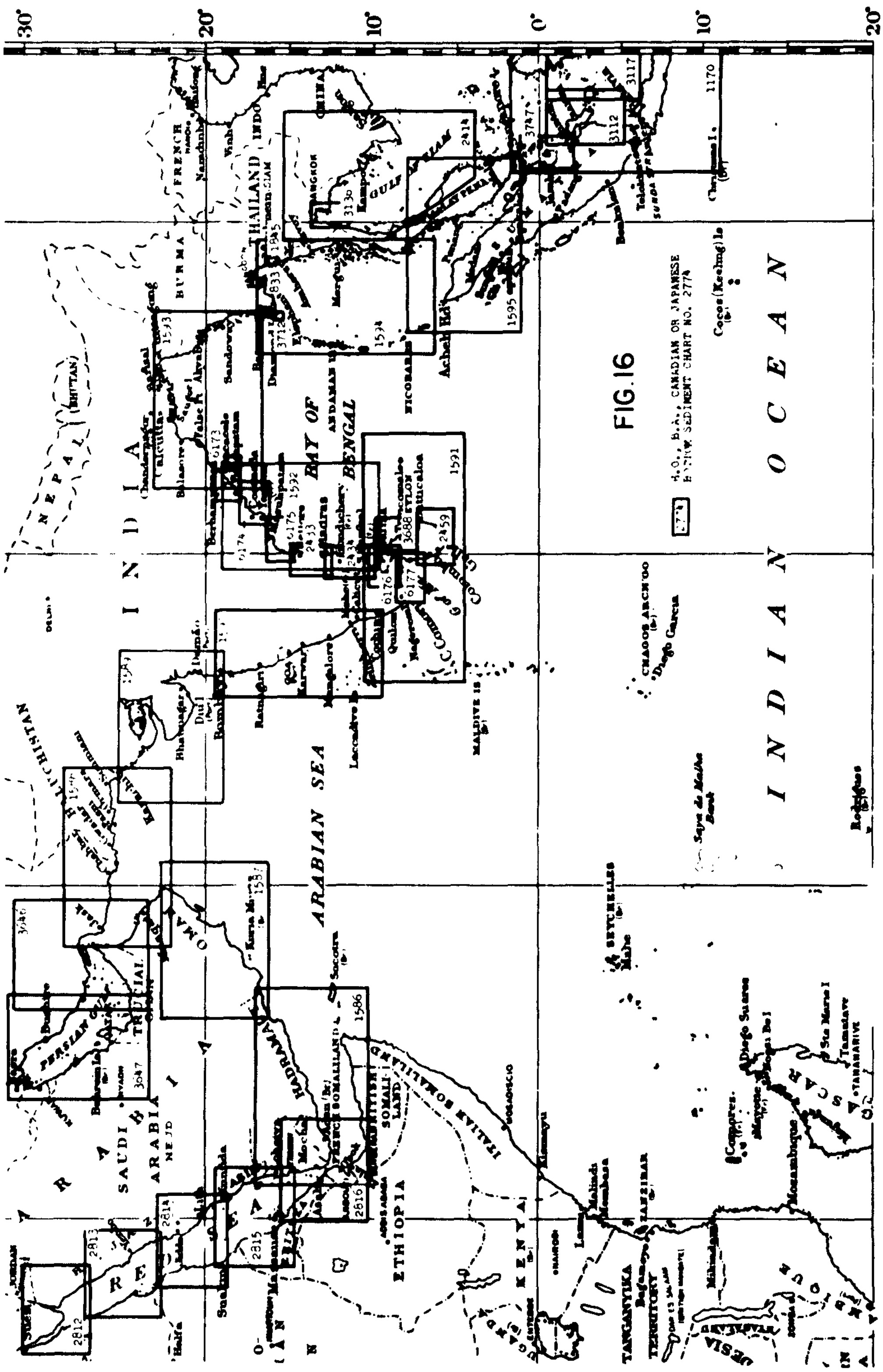


FIG. 16

H.O., B.A., CANADIAN OR JAPANESE BOTTOM SEDIMENT CHART NO. 2774

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Ireland. H.O. 146.
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British Islands Pilot. Vol V. The western coast of Scotland from Rud'h Re to Cape Wrath and the Hebrides Isles. H.O. 148.
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APPENDIX A

BOTTOM SEDIMENT CHARTS

The following numerical list of bottom sediment charts exist either in the original manuscript form or as printed charts at the U. S. Navy Hydrographic Office, Suitland, Maryland. Figure Nos. 8 to 16 indicate the position and area covered by each chart on a world map index. The following symbols hold for the charts listed below:

1. Chart numbers ending in BS indicate that the bottom sediment charts are machine printed. One copy of each of the machine printed bottom sediment charts is on file for reference at the Naval Ordnance Laboratory Library.

2. Chart numbers without the BS indicate that the bottom sediment charts are still in manuscript form.

3. Chart numbers ending in P are incomplete as far as bottom sediments are concerned.

4. Chart numbers ending in a indicate that the freehand charts have been copied by permission of the U. S. Navy Hydrographic Office and copies filed in the Naval Ordnance Laboratory Library for reference.

5. BA means British Admiralty Chart, JAP means Japanese Chart, USC+GS means U. S. Coast and Geodetic Survey Chart, and HO means U. S. Navy Hydrographic Office Chart.

JAP 0062-BS Honshu, Japan, Tokyo Kaiwan to Kinkasan. The Hydrographic Office number is HO 10,010-30-BS. Scale 1:508,540. Plans: Onahama Wan. Scale 1:38,000. Hirakata Hakuti. Scale 1:7,340.

HO 0068 a Bering Sea and Strait, Siberia and Alaska. Scale 1:3,436,385.

BA 0198 Italy, southern tip, Ionian Sea, Mediterranean Sea, Golfo di Taranto, Policastro to Capo Sta. Maria di Leuca.

BA 0199 a Coast of Italy, Adriatic Sea, Brindisi to Ortona. Scale 1:300,000.

BA 0200 Coast of Italy, Adriatic Sea, Ortona to the River Po.

HO 0453 South America, Argentina, Magellan Strait to Cape Horn. Scale 1:566,824.

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

BA 0581 Queen Charlotte and Johnson Strait, between Vancouver Island and British Columbia, West Coast of North America.

HO 0796-BS South China Sea, Northern Portion, Western Sheet. Scale 1:1,509,439.

HO 0797-BS South China Sea, Southern Portion, Western Sheet. Scale 1:1,576,943.

BA 0820-BS Africa, Northwest Coast, North Morocco, Cape Fdala to Cape Blanco.

BA 0833 Rangoon River and Approaches, Burma.

HO 0929 Harbor of Hong Kong and Approaches, China. Scale 1:30,000. Plan: Fattau Mun. Scale 1:12,000.

BA 0934 Surabaya and Sapudi Straits between Java and Madura.

HO 0940 (In Press) Cape Cod to Cape Breton, East Coast of U. S. Scale 1:909,786.

HO 0980 (In Press) Grand Banks of Newfoundland with Adjacent Coasts, Cape Bonavista to Cape St. Mary. Scale 1:677,743.

HO 0981 (In Press) Southeast Coast of Nova Scotia and Newfoundland, Cape Race to Halifax with the Outer Banks. Scale 1:689,869. Plan: Sable Island. Scale 1:330,000.

USC+GS 1007-A Gulf of Mexico (Bottom sediments indicated by printed notations)

HO 1013 (In Press) Gulf of St. Lawrence, Canada. Scale 1:734,542.

HO 1019-BS Gulf of Panama. Scale 1:290,372.

USC+GS 1106-BS Bay of Fundy to Cape Cod, East Coast of U.S. Scale 1:378,838.

USC+GS 1107-BS Georges Bank and Nantucket Shoals, East Coast of U. S. Scale 1:400,000.

USC+GS 1108 BS New York Harbor Approaches. Scale 1:400,000

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

USC+GS 1109-BS Cape May to Cape Hatteras, East Coast of U.S. Scale 1:416,944.

USC+GS 1110-BS Cape Hatteras to Charleson Light, East Coast of U.S. Scale 1:432,720.

USC+GS 1111-BS Charleson Light to Cape Carneval, East Coast of U.S. Scale 1:449,659.

USC+GS 1112-BS Cape Carneval to Key West, East Coast of U.S. Scale 1:466,940.

HO 1170 Java Sea, Western Part and the Southern passages to China. Scale 1:1,613,841.

JAP 1221-BS (HO 10,010-34-BS) Japan, Kyushu, Eastern Part of Osumi Kaikyo and Approaches.

HO 1277 Porto Do Funchal, Madeira Islands. Scale 1:7,500.

HO 1312 Madeira Islands, Arquipelago da Madeira. Scale 1:150,000. Plan: Porto da Cruz. Scale 1:20,000.

HO 1373 Flores Island in Azores Group, Eastern Atlantic Ocean, Ilha Do Corvo and Ilha Das Flores (Azores). Scale 1:145,700. Plan: Santa Cruz Anchorage (Ilha das Flores). Scale 1:24,320.

HO 1383 Korea, west coast, Approaches to Inch'on Hang. Scale 1:72,530. Plan: Kudo Anchorage.

HO 1454 Discovery Passage and Adjacent Waters Including Toba, Bute, and Louborough Inlets, between Vancouver Island and British Columbia, West Coast of North America. Scale 1:149,705.

HO 1455 Strait of Georgia and Adjacent Waters, between Vancouver Island and British Columbia, West Coast of North America. Scale 1:152,300.

HO 1583 Queen Charlotte Islands and Dixon Entrance, West Coast of North America, British Columbia. Scale 1:299,193

HO 1584 Hecate Strait, between Queen Charlotte Islands and British Columbia, West Coast of North America. Scale 1:299,198.

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

HO 1586-BS Gulf of Aden and Southern Part of the Red Sea. Scale 1:945,200.

HO 1587-BS Southeast Coast of Arabia, Ra's Al Hadd to Ra's Sajir. Scale 1:921,207.

HO 1588-BS Arabian Sea, Indian Ocean, Gulf of Oman and Adjacent Coasts from Karachi to Ra's Al Hadd. Scale 1:883,200.

HO 1589 Coast of British India, Karachi to Bombay including the Gulfs of Cutch and Cambay. Scale 1:903,367.

HO 1590 Southwest Coast of British India, Bombay to Cochin including the Laccadive Islands. Scale 1:945,197.

HO 1591 Southern Coast of British India, Cochin to Calimere Point with Ceylon and the Northern Portion of the Maldive Islands. Scale 1:964,514.

HO 1592 Coast of British India, Calimere Point to Calingapatam. Scale 1:945,197.

HO 1593-BS Coast of British India, Bay of Bengal, Calingapatam to Koronge Island. Scale 1:915,540.

HO 1594-BS Coast of British India, Bay of Bengal, Koronge Island to Salang or Junkseylon Island, including the Gulf of Martaban and the Andaman and Nicobar Islands. Scale 1:952,800.

HO 1595-BS Malacca Strait, Salang or Junkseylon Island to Singapore including Malay Peninsula and Northern Sumatra. Scale 1:971,599.

BA 1653A-BS Java, Western Portion including Sunda Strait.

BA 1653C Java, Eastern Portion

HO 1690 Islands off Kamchatka, Pacific Coast of U.S.S.R., Komandorskie Ostrova Islands. Scale 1:450,000. Plans: A. Staraya Gavan. Scale 1:12,000. B. Gavan Preobrazhenxkaya. Scale 1:6,000. C. Bukhta Peschanaya. Scale 1:20,000. D. Severnoe Lezhbische. Scale 1:20,000.

HO 1736 Azores Islands, Eastern Atlantic Ocean, Fayal, Graciosa, Terceira, Pico and San Jorge. Scale 1:160,000. Plans: Caldeira de Graciosa. Scale 1:35,000. Bahia Gomes. Scale 1:35,000. Praia de Graciosa. Scale 1:35,000. Bahia Praia. Scale 1:35,000. Bahia Angra. Scale 1:40,000.

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

HO 1739 Azores Islands, Eastern Atlantic Ocean, Sao Miguel and Santa Maria. Scale 1:146,000. Plans: Villa Franca Road. Scale 1:35,000. Bahia Villa de Porto. Scale 1:25,000. Bahia Sao Lourenco. Scale 1:25,000. Rocas Formigas. Scale 1:12,500. Dollabarat. Scale 1:12,500.

HO 1740 Canary Islands, Eastern Group, Northwest Coast of Africa. Scale 1:200,000. Plans: Ports Naos and Arrecife. Scale 1:15,000. Ensenada de Fustes. Scale 1:10,000. Strait of El Rio. Scale 1:40,000. Puerto de Cabras. Scale 1:40,000.

HO 1741 Canary Islands, Middle Group, Northwest Coast of Africa. Plans: Puerto de la'Orotava. Scale 1:70,000. Maspalemas Anchorage. Scale 1:15,000. Puerto de Gando. Scale 1:15,000. Puerto de La Luz. Scale 1:10,000. Bahia de Las Palmas. Scale 1:30,000.

HO 1742 Canary Islands, Eastern Group, Northwest Coast of Africa. Scale 1:175,000.

BA 1752-BS Cape Villano to Oporto, Spain and Portugal. Scale 1:200,000.

HO 1762 Inner Passages and Anchorages in Vicinity of Milbanke Sound, British Columbia, West Coast of North America. Fisher Channel to McKay Reach. Scale 1:299,198. Klemtu Passage and Anchorage. Scale 1:18,241. Bella Coola Anchorage. Scale 1:24,321. Nowish (Otter) Cove. Scale 1:18,241. Carter Bay. Scale 1:24,321.

BA 1845 Bay of Bengal, Burma, Moulmein River and Approaches.

HO 2067 Plans in the Gulf of Tartary, Siberia. A. Bukhta Datta and Approaches. Scale 1:35,100. B. Sovetskaya Gavan and Approaches. Scale 1:35,100.

HO 2124-BS Japan, Hokkaido and Approaches. Scale 1:701,732.

HO 2187-BS Kagoshima Kaiwan, Kyushu, Japan. Scale 1:100,000. Plans: Tomari Ura. Scale 1:24,000. Odomari Wan. Scale 1:9,000. Makurazaki Wan. Scale 1:18,000.

BA 2191-BS Gulf of Finland, Baltic Sea.

BA 2227 Gulf of Finland, Baltic Sea, Paker Ort to Ihasalu Point, includes Tallinn Harbor.

BA 2231 P a Cape Kali, Akra to Odessa, Black Sea, U.S.S.R.

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

BA 2232 a Odessa to Sevastopol, Black Sea, U.S.S.R.

BA 2233 a Sevastopol to Kerch, Black Sea, U.S.S.R.

BA 2234 a Sea of Azov, Black Sea Area, U.S.S.R.

BA 2252-BS Gulf of Bothnia, between Sweden and Finland.

BA 2278 a White Sea, North Russia.

BA 2279 Gulf of Finland, Eastern Part, Russia, Stirsudden to Leningrad.

HO 2338-BS Okinawa Gunto. Nansei Shoto or Southwestern Islands. Plan: Nago Wan, Okinawa Shima, March 1950.

HO 2340-BS West Coast of Africa, Cape Verde to Gambia River.

HO 2404-BS Imari Wan to Nagasaki Entrance, Japan.

BA 2414-BS Gulf of Thailand.

HO 2433 Eastern Coast of British India, Bay of Bengal, Madras to Ramiapatam. Scale 1:305,777. Plan: Madras Roadstead. Scale 1:24,592.

HO 2434 Eastern Coast of British India, Bay of Bengal, Calimere Point to Madras. Scale 1:308,017. Plans: Pondicherri Anchorage 1:29,688. Negapatam and Nagore Anchorages. Scale 1:41,065.

HO 2440 (In Press) Newfoundland and the Adjacent Coast of Labrador).

HO 2459 South Coast of Ceylon, off British India. Scale 1:312,620.

HO 2475-BS Northwest Coast of Kyushu with South Part of Tsushima, Plan: Kurara Seto. Japan.

HO 2500 Northern Part of Taiwan (Formosa), Koryu Hakuchi to Suo Wan. Scale 1:148,086.

BA 2637-BS South Part of the Strait of Macassar.

BA 2701 Strait of Oranto between Ionian Sea and Adriatic Sea, Coast of Albania and Italy, Gulf of Kotor to Corfu.

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

BA 2700 a Adriatic Sea, Coast of Yugoslavia, Gulf of Quarnaro, Cape Promontore to Dugi Island

BA 2712 a Adriatic Sea, Coast of Yugoslavia, Drvenik Channel to Korcula.

BA 2713 a Adriatic Sea, Coast of Yugoslavia, Korcula to Kotor.

HO 2725-BS Honshu, East Coast, Nakayama Saki to Miyako Ko, Japan.

HO 2726-BS Honshu, Miyako Ko to Ishinomako, Japan.

HO 2728-BS Soya Kaikyo (La Perouse Strait), Japan.

HO 2732-BS Noto Peninsula, Japan.

HO 2733-BS Amarube Zaki to Ando Zaki, including Wakasa Wan, Japan.

BA 2733-BS Iceland, Southwest Coast.

BA 2751-BS Svalbard, Arctic Sea.

BA 2774 a Adriatic Sea, Coast of Yugoslavia, Dugi Island to Drvenik Channel.

HO 2812-BS Red Sea (Sheet I). Plans: Tor Harbor, Tiran Is. Anchorage, Sherm Yahar, Sherm Jubba.

HO 2813-BS Red Sea (Sheet II). Plans: A. Scout Anch. B. The Brothers Islands. C. Koseir Anch. D. Sherm Wej (El Weg). E. Sherm Hassey. F. Daedalus Reef. G. Yenbo. H. Sherm Rabegh.

HO 2814-BS. Red Sea (Sheet III). Plans: Khor Delwen (Dhu-L Lawa), Khor Shinab, Nersa Ar Hakiyai, Lith, Jelajil, Kunfida (Al Qunfidha).

HO 2815-BS Red Sea (Sheet IV). Masamirit Island to Subair Is. Plans: Gubbet Mus Nefit, Nocra Anch. and Channel.

HO 2816-BS. Red Sea and Gulf of Aden, Subair Is. to Aden.

BA 2842a-BS Baltic Sea (Western Sheet).

BA 2842B-BS Baltic Sea (Eastern Sheet).

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

BA 2961 Arctic Russia, Pyechora Bay (Near Archangel).

HO 2972 P Blanch Bay, New Britain.

BA 2976-BS Iceland-West Coast. Snaofellsjokull to North Cape.

BA 2977-BS Iceland, North Cape to Siglu Fjord including Skagastrand Bay. Plans: Kalfshamarsnes, Hunafloi (Skagastrand Bay), Elonducs, Huna Fjord, Selvik, Skaga Fjord, Haganesvik.

BA 2978-BS Iceland, North Coast.

BA 2979-BS Iceland, East Coast.

BA 2980-BS Iceland, South Coast.

HO 3001 East Java Sea, Makassar Strait, West Flores Sea.

HO 3045-BS Same as HO 2637-BS. South Part of Strait of Macassar.

HO 3053 P East Borneo Bays.

HO 3054 P Ports in Macassar Strait, Celebes Island.

HO 3112-BS Banka and Gaspar Straits, South China and Java Seas.

HO 3117-BS Karimata Strait, South China and Java Seas.

HO 3136 Gulf of Siam.

HO 3149-BS French Indo-China, Camranh Bay to Cape Varella.

HO 3161 P French Indo-China, Haiphong.

HO 3176-BS Formose Strait and Taiwan (Formosa) with the Adjacent Coast of China, From Hong Kong to Foochow.

HO 3199 Coast of China, Macao to Pedro Blanco including Hong Kong. Scale 1:175,000. Plan: Samun Road. Scale 1:45,700.

HO 3240-BS Kurile Islands, Uruppu To and Approaches.

HO 3241 Southeast Coast of Korea

HO 3303-BS Honshu and Hokkaido-Honshu, Japan.

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

HO 3414 France, Mediterranean Coast, Approaches to Marseilles

HO 3646-BS Persian Gulf, Eastern Sheet

HO 3647-BS Persian Gulf, Western Sheet.

HO 3688 Ceylon, East Coast, Batticaloa Roads to Point Pedro. Scale 1:311,120. Plan: Batticaloa Roads. Scale 1:18,600.

HO 3712 Burma Coast, Bay of Bengal, Bassein River and Approaches

HO 3747-BS Singapore Strait to Banko Strait,

HO 3748 Singapore Strait, Western Part.

HO 3749 Singapore Strait, Eastern Part.

HO 3923A Aegean Sea. Scale 1:768,450.

HO 3929 Strait of Gibraltar to Adra. Scale 1:235,554.

HO 3930 Adra to Cartegena, Spain, Mediterranean Sea. Scale 1:233,640. Plans: Ensenada de Mazarren. Scale 1:50,000. Puerto de Aguilas and Puerto del Hornillo. Scale 1:25,000. Puerto de Almerid. Scale 1:25,000. Puerto de Porman. Scale 1:15,000. Ensenada de San Pedro. Scale 1:25,000. Puerto Genoves and Ensenada de San Jose. Scale 1:25,000.

HO 3931 Cartagena to Cabo de San Antonio, Spain, Mediterranean Sea, Scale 1:230,535. Plans: Ensenada de Javea. Scale 1:20,000. Calpe Anchorages. Scale 1:30,000. Ensenada de Morayra. Scale 1:20,000.

HO 3932 Cabo de San Antonio to Cabo de Tortosa, Spain. Mediterranean Sea. Scale 1:224,898. Plans: Puerto de Vinaroz. Scale 1:12,500. Puerto de Sagunto. Scale 1:10,000. Puerto de Gandia. Scale 1:10,000. Pensicola Road. Scale 1:12,500.

HO 3933 Cabo de Tortosa to Cabo de San Sebastian, Spain, Mediterranean Sea. Scale 1:220,835.

HO 3934 Cabo de San Sebastian to Sete, Spain and France, Mediterranean Sea. Scale 1:215,181.

HO 3936 Marseille to San Remo, France and Italy, Mediterranean Sea. Scale 1:212,866.

BOTTOM SEDIMENT CHARTS

HO 3955 a Gulfs of Venice and Trieste, Adriatic Sea.

HO 4184 Sea of Marmara, Turkey. Scale 1:271,690.

USC+GS 4255 Manila Bay, Phillipine Islands.

HO 4291-BS Libya, Mediterranean Sea, Ras El Hilal to Ras Azz.

HO 4292-BS Libya, Mediterranean Sea, Bengasi to Ras El Hilal.

HO 4293-BS Libya, Mediterranean Sea, Sirte to Tolemaide.

HO 4294-BS Libya, Mediterranean Sea, Ras Ashdir to Sirte.

USC+GS 4309 Balebac Strait between the Philippine Islands and Borneo.

HO 4327-BS Coast of France, Raz de Sein to Goulven including Ile D'Ouessant (Ushant Island) and Brest.

HO 4328-BS Coast of France, Ile de Groix to Raz de Sein.

HO 4332 Bay of Biscay, France, Pointe D'Arcachon to Pointe de la Coubre. Scale 1:145,843.

HO 4333 Bay of Biscay, France and Spain, San Sebastian to Pointe D'Arcachon. Scale 1:145,812. Plans: Rada de Higuer (Baie de Fontarabie). Scale 1:30,000.

HO 4380-BS North and West Coast of Spain, Cabo Silleire to Cabo de Penas.

HO 4402-BS Cape St. Vincent to the Strait of Gibraltar.

HO 4431 English Channel (La Manche). Scale 1:806,500

HO 4436 Irish Sea with St. Georges and North Channels and Bristol Channel. Scale 1:497,638.

HO 4437 West Coast of Ireland. Scale 1:497,638.

HO 4441 West Coast of Scotland. Scale 1:455,750.

HO 4672-BS Faeroe Islands.

HO 4688 Fisherrow to Port Edgar (Firth of Forth), Scotland. Scale 1:24,410.

HO 4841 The North Sea, Southern Sheet. Scale 1:746,457.

HO 4842 The North Sea, Middle Sheet. Scale 1:684,750.

BOTTOM SEDIMENT CHARTS

HO 4843 The North Sea, Northern Sheet. Scale 1:615,520.

CANADIAN 5000 Hudson Bay and Strait.

HO 5002-BS Approaches to the Panama Canal.

HO 5005-BS Norway, the Naze (Lindnesnes) to the North Cape (Nord Kap).

USC+GS 5022 Cape Blanco to Cape Flattery, Pacific Northwest Coast of United States, Scale 1:736,560.

HO 5281 P Argentina, Rio de la Plata to Bahia Blanca.

HO 5282 Argentina, Bahia Blanca to Golfo Nuevo

HO 5283 Argentina, Golfo Nuevo to Puerto San Julian.

HO 5284 P Argentina, Puerto San Julian to Magellan Strait with Part of Falkland Islands.

HO 5310 Taiwan (Formosa), north coast, Approaches to Kiirun (Keelung) Ko. Scale 1:18,100

HO 5316-BS Naikai or Setouchi (Inland Sea), Western Part, Japan.

HO 5317-BS Naikai or Setouchi (Inland Sea), Eastern Part, Japan.

HO 5322-BS Kuril Islands, Paramushiru To and Approaches.

HO 5323-BS Kuril Islands, Shasukaton To to Makanru To.

HO 5326-BS Kuril Islands, Uruppu To and Approaches.

HO 5327 Kuril Islands. Chishima Retto, between North Pacific Ocean and Okhotsk Sea, Etorofu To. Scale 1:225,515. Plans: A. Utasutsu Wan. Scale 1:145,985. B. Tannenoe Wan and Moekeshi Wan. Scale 1:145,455. C. Moyore Wan. Scale 1:72,960. D. Shamanbe Byochi and Bettobu Byochi. Scale 1:48,660. E. Shibetoro Byochi, Scale 1:48,660.

HO 5361 Approaches to Queen Charlotte Strait, British Columbia, West Coast of North America. Scale 1:312,830.

HO 5362 Strait of Juan de Fuca to Cape Cook, Part of Vancouver Island and State of Washington, West Coast of North America. Scale 1:326,096.

HO 5466-BS Southern Part of Tokyo Maiwan, Japan.

HO 5467-BS Middle Part of Tokyo Maiwan, Japan.

HO 5492 a Honshu, Japan. South Coast, Shikoku.

BOTTOM SEDIMENT CHARTS

HO 5493-BS Yellow Sea, Northern Part, Hwang Hai with Gulfs of Pohai and Liaotung.

HO 5494-BS Yangtze River Entrance, China Coast. to Shimonoseki Kaiyo Including the Coast of China to Tsingtao, Southern Part of Chosen (Korea) and the West Coast of Kyushu.

HO 5495-BS Coast of China, Formosa Strait to Yangtze Entrance.

HO 5677-BS Bono Misaki to Naga Shima, Kyushu-West Coast, Japan.

HO 5679-BS Iro Saki to Shiono Misaki, Honshu-South Coast, Japan.

USC+GS 5802 Cape Blanco to Yaquina Head, Oregon, Northwest Coast of the United States. Scale 1:191,730.

HO 5805 Philippine Sea, Scale 1:4,144,600.

HO 5810 Southern tip of Kamchatka, Russia, Mys Lopatka to Mys Shipunski. Scale 1:450,670. Plans: A. Mys Zhupanova Anchorage. Scale 1:40,000. B. Approaches to Reka Vakhil. Scale 1:110,740.

HO 5812 Pacific Coast of Russia, Mys Kamchatski to Mys Ilpinski

HO 5813 Pacific Coast of Russia, Mys Ilpinski to Mys Olyutorski.

HO 5814 Pacific Coast of Russia, Siberia, Mys Olyutorski to Mys Rubikon.

HO 5815 Pacific Coast of Russia, Siberia, Mys Rubikon to Mys Gintera.

HO 5816 Pacific Coast of Russia, Siberia, Mys Gintera to Zaliv Krests Including Andyr Bay.

HO 5817 Pacific Coast of Russia, Siberia, Zaliv Krests to Mys Nygligan.

HO 5819 Pacific Coast of Russia, Siberia, St. Lawrence Island to Bering Strait.

USC+GS 6002 Columbia River to Destruction Island, Oregon and Washington, Northwest Coast of United States. Scale 1:180,789.

USC+GS 6102 Approaches to Strait of Juan de Fuca-Destruction Island to Amphitrite Point, Washington and British Columbia, Northwest Coast of North America. Scale 1:176,253.

HO 6125 Southwest Coast of Taiwan (Formosa), Garan Bi to Takoa Ko. Scale 1:157,460.

BOTTOM SEDIMENT CHARTS

HO 6167 Ilheus Selvagem (Salvage Islands), Off northwest coast of Africa, Atlantic Ocean. Scale 1:103,640. Plans: Selvagen Pequena. Scale 1:20,700. (Great Piton I) and Ilheu de Fora (Little Piton I) Selvagem Crande (Great Salvage I). Scale 1:20,625.

HO 6173 Bay of Bengal, Coast of India, Bimlipatam to Gopalpur. Scale 1:298,600. Plans: A. Baruva Anchorage. Scale 1:18,780. B. Pundi River Entrance. Scale 1:10,690. C. Bimlipatam Anchorage. Scale 1:18,480.

HO 6174 Bay of Bengal, Coast of India, Narasapur to Rhee Munidatnam, Scale 1:300,970. Plan: Cocanade Bay. Scale 1:49,400.

HO 6175 Bay of Bengal, Coast of India, Ramaputnam to Narasapur Point. Scale 1:303,250. Plan: Masulipatam Roads. Scale 1:49,400.

HO 6176 Southeastern Coast of India and Northern Coast of Ceylon, Palk Strait and Gulf of Mannar (northern part). Scale 1:310,340.

HO 6177 Southern tip of India and west coast of Ceylon, Gulf of Mannar (southern part). Scale 1:311,770.

HO 6210 French Indochina, Cu Lao Cham to Hue including Baie de Tourane. Scale 1:153,075.

HO 6243 Sakhalin Island, off coast of Siberia, Honto Ko to Kushunnai Hakuchi. Scale 1:165,950.

USC+GS 6300 Georgia Strait and Strait of Juan de Fuca, Washington and British Columbia, Northwest Coast of North America, Scale 1:200,000.

USC+GS 6401 Admiralty Inlet and Puget Sound, Washington, Northwest Coast of United States. Scale 1:150,000.

HO 6418 Southern Part of Island of Hain-nan Tao, off coast of French Indochina, Tonkin Gulf Area, San-ya Chiang and Yu-lin Chiang. Scale 1:30,000.

HO 6515 Korea, east coast, Japan Sea, Yonghung (Eiko) Man. Scale 1:37,950.

HO 6534 Korea, west coast, Yongmae Do to Yongjong Do. Scale 1:75,000.

HO 6535 Korea, west coast, Kwansan to Kyongsons (Seoul) Hangang. Scale 1:75,000.

HO 6536 Korea, east coast. Chosan Man. Scale 1:35,000.

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

JAP 7002-BS Toyanawan, Japan.

JAP 7004-BS Adjacent Seas of Hatinohe, Southern Part, Japan

JAP 7051-BS Adjacent Seas of Hokkaido Honte, Sheet 1, Japan.

JAP 7052-BS Adjacent Seas of Honsyu, Sheet 2, Japan.

JAP 7053-BS Adjacent Seas of Japan, Sheet 3, Siberia, Korea

JAP 7054-BS Adjacent Seas of Japan, Sheet 4, Kyushu, Sikoku.

USC+GS 8002 Dixon Entrance to Cape St. Elias, Alaska. Scale 1:969,756.

USC+GS 8102 Hecate Strait to Etolin Island, including Behm and Portland Canals, Alaska. Scale 1:229,376.

USC+GS 8152 Dixon Entrance to Chatham Strait, Alaska. Scale 1:229,376.

USC+GS 8201 Etolin Island to Midway Islands, including Sumner Strait, Alaska. Scale 1:217,828.

USC+GS 8202 Midway Islands to Cape Spencer, including Lynn Canal. Alaska, Scale 1:209,978.

USC+GS 8252 Coronation Island to Lisianski Strait, Alaska. Scale 1:217,828.

USC+GS 8402 Cross Sound to Yakutat Bay, Alaska. Scale 1:300,000.

USC+GS 8502 Cape St. Elias to Shumagin Islands, Alaska. Scale 1:969, 761.

USC+GS 8551 Prince William Sound, Alaska. Scale, 1:200,000

USC+GS 8552 Point Elrington to East Chugach Island, Alaska. Scale 1:200,000.

USC+GS 8553 Cook Inlet - Northern Part, Alaska. Scale 1:194,154.

USC+GS 8554 Cook Inlet - Southern Part, Alaska. Scale 1:200,000

USC+GS 8556 Kodiak Island, Coast of Alaska. Scale 1:350,000.

USC+GS 8850 Aleutian Islands, Alaska Peninsula, Shumagin Islands to Sanak Islands.

USC+GS 8860 Aleutian Islands. Unimak and Akutan Passes and Approaches.

APPENDIX A (Cont'd)

BOTTOM SEDIMENT CHARTS

USC+GS 8861 Aleutian Islands, Unalaska Island to Amukta Island.

USC+GS 8862 Amukta Island to Igitkin Island, Aleutian Islands.

USC+GS 8863 Aleutian Islands, Igitkin Island to Semisopochnoi Island.

USC+GS 8864 Aleutian Islands, Rat Islands-Semisopochnoi Island to Buldir Island.

USC+GS 8865 Aleutian Islands, Near Islands-Buldir Island to Attu Island.

USC+GS 8995 Pribilof Islands, Bering Sea.

USC+GS 9008 Dutch Harbor Unalaska Island, Fox Islands.

USC+GS 9198 Near Islands, Ingenstrom Rocks to Attu Island.

USC+GS 9302 Bering Sea - Eastern Part.

USC+GS 9380 Norton Sound, Coast of Alaska, Alaska side of Bering Strait.

HO 10,010-120 Korea, west coast, Inch'on Ko (Zinsen Ko). Scale 1:15,590.

HO 10,639-69 Russia, Berents Sea, Southwest Coast, Mys Severnyy Gusinyy Nos to Ostrova Sakhanina, Novaya Zemyla. Scale 1:203,500.

HO 10,639-114 Russia, Pacific Coast, Kamchatka-West Coast, Reka Ozernaya to Reka Kiknchik. Scale 1:250,100

HO 10,639-117 Russia, Pacific Coast, Siberia, Okhotsk Sea, Ostrov Spafar'yeva to Yamskiye Ostova. Scale 1:584,250.

HO 10,639-124 Russia, Pacific Coast, Sakhalin-East Coast, Mys Yelizavety to Zaliv Pil'tun. Scale 1:250,600. Plan: Urkt Road (Okha Road).

HO 10,639-127 Russia, Pacific Coast, Tartary Strait between Siberia and Sakhalin Island, Zaliv de Kastri to Zakhalinskiy Climan of Reka Amur. Scale 1:284,600.

APPENDIX B

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

The following list of Hydrographic Oceanographic Data Sheets (HODS) are oceanographic studies based on extensive surveys of the scientific literature made by the U.S. Navy Hydrographic Office. The list includes HODS now being compiled and HODS tentatively scheduled for the future; there may be deletions and additions. The Hydrographic Office Call Number is given where it has been assigned, and the Naval Ordnance Laboratory Library Number is given provided copies are in the Library. Parenthesis around the "H.O. Call No." means that the work has not been completed. The list of HODS is given by areas to correspond with the areas discussed in this report; the additional HODS are listed under appropriate areas. These additional areas are included in an effort to make this report as comprehensive as possible. The classification of these HODS is CONFIDENTIAL.

British Isles and Vicinity (Channel Coast)	H.O.Call No.	NOL Lib.No.
Calais, France	(0230-0339)	
Boulogne, France	(0230-0180)	
Dieppe, France	(0230-9929)	
Le Havre, France	(0230-9988)	
Caen, France	(0230-9941)	
Cherbourg, France	(0230-9989)	
Dunkerque, France	(0230-9924)	
French West Approaches		
Bayonne (complex), France	0319-9998	C-50255
Bilbao, Spain	(0319-9957)	
Bordeaux (complex), France	0254-9998 0254-0023	C-50242

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

French West Approaches (Cont'd)	H.O.Call No.	NOL Lib. No.
Brest (complex), France	0229-9999	C-50237
Cherbourg, France	(0230-9989)	
La Pallice (complex), France	0254-9991	C-50259
Lorient (complex), France	0254-9992	C-50258
Pasajes, Spain	(0319-9962)	
Santander, Spain	(0319-9963)	
Saint-Nazaire (complex), France	0254-9994	C-50243
Baltic Sea Area		
Skagerrak		
Arendal	(0151-0103)	
Frederikstad	(0151-0199)	
Halden	(0152-0272)	
Horten	(0151-9988)	
Kragero	(0151-0110)	
Kristiansand	(0151-0097)	
Langesund-Brevik	(0151-0160)	
Larvik-Sandefjord	(0151-0108)	
Oslo	(0151-9997)	
Uddevalla	(0152-0301)	
Kattegat		
Aabenrea-Flensburg	(0170-0480)	
Aalborg-Hirtshals	(0151-0115)	
Aarhus-Horsens	(0151-0096)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Baltic Sea Area (Cont'd)	H.O.Call No.	NOL Lib. No.
Kattegat (Cont'd)		
Fredericia-Kolding	(0170-0028)	
Goteborg	(0152-9986)	
Halmstad	(0152-0304)	
Halsingborg-Landskrona	(0152-9992)	
Kobenhavn-Malmo	(0169-9987)	
Nakskov	(0170-0484)	
Odonse	(0170-0028)	
Baltic Sea		
Abus-Karlshamn	(0169-0425)	
Gdynia-Gdansk	(0169-9992)	
Harsfjarden	(0152-0302)	
Kalmar Channel	(0152-0308)	
Karlskrona	(0152-9985)	
Kiel	(0170-9989)	
Klaipeda	(0168-9990)	
Liepaja	(0152-9999)	
Norrkoping	(0152-9989)	
Oskarshamn	(0152-0278)	
Parnu	(0153-0518)	
Riga	(0153-9998)	
Ronne	(0169-0427)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Baltic Sea Area (Cont'd)	H. O. Call No.	NCL Lib. No.
Baltic Sea (Cont'd)		
Rostock	(0169-9995)	
Stockholm	(0152-9988)	
Stralsund	(0169-9928)	
Swinemunde	(0169-9981)	
Vastervik	(0152-0307)	
Ventspils	(0152-0279)	
Wismar	(0170-9998)	
Ystad-Trelleborg	(0169-0426)	
Gulf of Bothnia		
Gavle	(0104-0149)	
Jakobstad	(0103-0169)	
Kemi	(0091-0056)	
Lulea	(0090-0061)	
Ornskoldsvik	(0104-0153)	
Oulu	(0091-0053)	
Pori	(0103-9981)	
Rauma	(0103-0049)	
Sonderhamn	(0104-0195)	
Sundsvall	(0104-0195)	
Umea	(0103-0154)	
Vaasa	(0103-9978)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

	H.O. CALL No.	NOL Lib. No.
Baltic Sea Area (Cont'd)		
Gulf of Finland		
Hango	(0153-0473	
Helsinki	(0103-9982)	
Kotka	(0103-9971)	
Koyvisto	(0103-0167)	
Kronshtadt	(0153-9991)	
Paldiski	(0153-0469)	
Porkkala	(0153-0478)	
Tallinn	(0153-9999)	
Tarku	(0103-9979)	
Vyborg	(0103-0047)	
White Sea Area		
Arkhangel'sk	(0092-9999)	
Belomorsk	(0091-0036)	
Kandalaksha	(0091-9998)	
Kem'	(0091-0065)	
Yellow and China Seas Area		
Yellow Sea with Gulfs of Pohai and Liaotung		
Ch'ing-tao (Tsingtao)	0381-9996	C-56267
Ch'in-huang-tao Approaches	0381-0094	
Chinnamp'o Approaches	(0380-0204)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

	H.O. Call No.	NOL Lib. No.
Yellow and China Sea Areas (Cont'd)		
Yellow Sea with Gulfs of Pohai and Liaotung (Cont'd)		
Hu-Lu-Tao Approaches	0289-9998 0289-9997 0289-0097	
Inch-On	(0380-9998)	
Ta-Lien (Dairen)	0381-9997 0381-9998	
T'ien-Ching (Tientsin)	0381-9999 0381-0201	
Yen-T'ai Approaches (Chefoo)	0381-0203 0381-0309 0381-0308	C-56268
Tasado	0380-0073	
East China Sea		
Fu-Chou (complex), China	0499-9999	C-54515
Pusan	(0387-9999)	
Shang-Hai (Shanghai)	S 0614-9997	C-56265
T'ai-Pei (Taihoku)	0499-9998	C-56266
South China Sea		
Cam Ranh entrance, Baie (Bay) de Cam Ranh, Indochina	0740-0002	C-54525
Haiphong (complex), Indochina	0616-9999	C-54521
Hanoi (complex), Indochina	0616-9998 0616-0015	C-54524
Hong Kong (complex), China	0614-9997	C-54512
Hsia-men (Amoy), China (complex)	0498-9999	C-54516

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

	H.O. Call No.	NOL Lib. No.
South China Sea (Cont'd)		
Kao-Hsiung (Takao), Formose	0613-9999	C-56264
Krung-Thep (Bangkok), Thailand (Complex)	0678-9999 0040-0678	C-52039
Kuang-Chou (Canton) (Complex), China	0614-9998 0614-0055	C-54514
P'eng-hu Mako (Formosa Strait)	(0613-0072)	
Saigon (complex), Indochina	0739-9999	C-54,522
Shan-t'ou (Swatow), China (complex)	0614-9999	C-54,513
Singapore (complex), Malaya	0860-9999	C-52,046
Yu-Lin Approaches	0618-0018	C-54,523
Mediterranean Sea Area		
Western Mediterranean Sea		
Barcelona		
Civitavecchia approach, Italy	0321-0010	C-52,038
Genova (complex), Italy	0253-9989	C-50260
Golfo di Napoli, Italy	0321-0065 0321-0099	C-50,250
La Spezia (complex), Italy	0253-9988	C-50261
Livorno (complex), Italy	0320-9996	C-50254
Maseille (complex), France Port-de-Bouc (complex), France	0320-9995 0320-9950	C-50253
Palermo (complex), Sicily	0344-9996	C-50287
Savona (complex), Italy	0253-9983	C-50238
Riva Tregoso, Italy	(0253-0335)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Mediterranean Sea Area (Cont'd)	H.O.Call No.	NOL Lib.No.
Western Mediterranean Sea (Cont'd)		
Salerno, Sicily	(0321-0038)	
Sannazzaro, Italy	(0321-0065)	
Castell Del Ovo, Italy	(0321-0099)	
Sete (complex), France	0320-9992	C-50252
Tarragona, Spain	0319-9958	
Toulon (complex), France	0320-9997	C-50267
Adriatic Sea		
Ancona (complex), Italy	0321-9997	C-50274
Bari (complex), Italy	0321-9996	C-50273
Brindisi (complex), Italy	0321-9995	C-50272
Dubrovnik Approaches, Yugoslavia	0321-9989	C-50249
Durres Bay, Albania	0322-9995	C-50256
Fiume Gulf, Yugoslavia	0252-9996	C-50239
Gulf of Trieste, Italy	0252-0137 0252-0240	C-50244
Kabila Point, Topla Bay, Yugoslavia Ostri Point, Topla Bay, Yugoslavia	0321-0024 0321-0016	C-50264
Ploce Approaches, Yugoslavia	0321-0011	C-50265
Pula Approaches, Yugoslavia	0252-9982	C-50241
Sibenik Approaches, Yugoslavia	0321-9990	C-50262
Split Approaches, Yugoslavia	0321-9998	C-50278
Treporti Cape, Vlore Bay, Albania Nicola Bay, Sazeno Island, Vlore Bay	0322-0186 0322-0217	C-50277

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Mediterranean Sea Area (Cont'd)	H.O.Call No.	NOL Lib.No.
Adriatic Sea (Cont'd)		
Venezia Gulf, Italy	0252-9985	C-50240
Eastern Mediterranean Sea		
Alexandria	(0448-9999)	
Beirut (complex), Lebanon	0426-9999	C-50232
Dardanelles Entrance (Aegean Sea), Turkey	0322-0219	C-50276
Gallipoli peninsula (Sea of Marmara), Turkey	0322-0230	C-50257
Haifa (complex), Israel	0426-9997	C-50231
Iskenderun Korfezi (complex), Turkey	0341-0067	C-50275
Izmir (complex), Turkey	0342-9999	C-50271
Kalamai (complex), Greece	0343-9997	C-50269
Patrai, Greece	(0343-0085)	
Piraievs, (complex), Greece	0343-9998	C-50288
Port Said, Egypt	(0447-9993)	
Sidon, Syria	(0426-0070)	
Tarabulus Esh Sham (Tripoli) (complex), Lebanon	0426-0046	C-50286
Taranto (complex), Italy	0321-9991	C-50263
Thessaloniki (complex), Greece	0322-9996	C-50268
Volos Approaches, Greece	0343-0024	C-50270
Black Sea		
Batumi (complex), U.S.S.R.	0324-9998	C-50279

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Mediterraneon Sea Area (Cont'd)	H.O.Call No.	NOL Lib.No.
Black Sea (Cont'd)		
Bratul Sulina (Danube River Estuary), Rumania	0250-0131	C-50248
Burgas (complex), Bulgaria	0323-9996	C-50284
Constanta (complex), Rumania	0250-9908	C-50247
Feodosiya (complex), U.S.S.R.	0249-9927	C-50236
Golcuk approaches, Turkey	0323-0111	C-50285
Istanbul (complex), Turkey	0323-9998	C-50283
Kerch' (complex), U.S.S.R.	0249-9999	C-50234
Novorossiysk (complex), U.S.S.R.	0249-9976	C-50235
Ochakovskiy Mys (Point), Kneprovskiy Liman (Bay), U.S.S.R.	0250-0108	C-50233
Ochemchiri harbor entrance, U.S.S.R.	0324-0079	C-50281
Odessa (complex), U.S.S.R.	0250-9997	C-50245
Poti (complex), U.S.S.R.	0324-9997	C-50280
Samsun, Turkey	(0324-0098)	
Sevastopol' (complex), U.S.S.R.	0250-9996	C-50246
Sinop, Turkey	(0324-0100)	
Trabzon, Turkey	(0324-0096)	
Tuapse (complex), U.S.S.R.	0249-9991	C-50251
Varna (complex), Bulgaria	0323-9999	C-50282
Zhdanov (Sea of Azov), U.S.S.R.	(0249-9995)	
Zonguldak	(0323-0096)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Additional Areas	H.O.Call No.	NOL Lib.No.
Arabian Sea		
Bombay	(0673-9999)	
Karachi	(0550-9999)	
Barents Sea		
Belush'ya	0030-0003	
Guba Motka	(0051-0045)	
Kirkenes	(0051-0051)	
Murmansk	(0051-9999)	
Nar'yan-Mar	0030-0001	
Pechenga	(0051-0061)	
Teriberka	(0051-0079)	
Yokan'ga	(0051-0047)	
Bay of Bengal		
Calcutta	(0558-0025)	
Chittagong (complex), Pakistan	0557-0000	C-52038
Madras	(0681-9999)	
Rangoon (complex), Burma	0677-0000 0677-0025	C-52043
Trincomalee	(0796-9999)	
Visakhapatnam	(0674-0010)	
Bering Sea		
Anadyr Bay	(0075-0008)	
Provideniya Bay	(0075-0009)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Additional Areas (Cont'd)	H.O.Call No.	NOL Lib.No.
Caspian Sea		
Baku	(0325-9999)	
Makhackala	(0325-9994)	
Gulf of Aden		
Aden	(0687-9999)	
Japan Sea		
Tetyukhe	(0282-9994)	
Laccadive Sea		
Cochin	(0795-9999)	
Colombo	(0803-9999)	
North Sea		
Amsterdam	(0170-9986)	
Borgen	(0105-9999)	
Elbe	(0170-0070)	
Emden	(0170-0075)	
Esbjerg	(0170-0083)	
Farsund	(0151-0101)	
Flekkefjord	(0151-0198)	
Haugesund	(0151-0094)	
Rotterdam	(0230-9967)	
Stavanger	(0151-0165)	
Walcheren-Zuidbeveland Kanaals	(0230-0344)	
Wilhelmshaven-Weser	(0170-0076)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Additional Areas (Cont'd)	H.O.Call No.	NOL Lib.No.
North Atlantic Ocean		
Reykjavik	(0087-9999)	
Norwegian Sea		
Alesund	(0105-0039)	
Bodo	(0090-0069)	
Hammerfest	(0052-0026)	
Harstad	(0052-0024)	
Kristiansund	(0105-0034)	
Molde	(0105-0040)	
Mosjoen	(0090-0059)	
Namsos	(0090-0060)	
Narvik-Ramsund	(0052-0021)	
Tromso	(0052-0031)	
Trondheim	(0104-9999)	
Pacific Coastal Area of U.S.S.R.		
Aleksandrovsk	(0205-9999)	
Chongjin	(0290-9997)	
Dekastri Bay	(0204-0079)	
Hungnam-Wonsan	(0380-9999) (0380-9997)	
Katangli	(0205-0023)	
Khoy	(0205-0022)	

APPENDIX B (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

Additional Areas (Cont'd)	H.O.Call No.	NOL Lib.No.
Pacific Coastal Area of U.S.S.R. (Cont'd)		
Lozhnykh Vestev Bay Anchorage (Karaga Bay Anchorage)	(0132-0001) (0132-0002)	
Magadan	0131-9999	
Maoka (Kholmsk)	0281-9991 0281-0025	
Moskalvo	0196-0015 1096-0023	
Nakhodka	0291-9996	C-54517
Nevelskogo Bay	(0196-0024)	
Nikolayevsk	0196-9998	
Nikolskoye Anchorage	0193-0001	
Okhotsk	(0130-0025)	
Ol'gi Zaliv (Gulf) Vladimira	0291-0079 0291-0080	C-54518
Otomari (Korsakov)	0281-9998	
Paramushiru-kaikyo (Strait)	0206-0005 0206-0008	
Petropovlovsk-kamchatskiy	0194-9999	
Pos'yeta Zaliv (Gulf)	0290-0182 0291-0120	C-54520
Rubetsu-hitokappa Bays Anchorage	0280-0005 0280-0006	
Songiin	(0290-9995	
Sovetskaya Gavan	0204-9994	
Uglegorsk	(0205-0016)	

APPENDIX 3 (Cont'd)

HYDROGRAPHIC OCEANOGRAPHIC DATA SHEETS

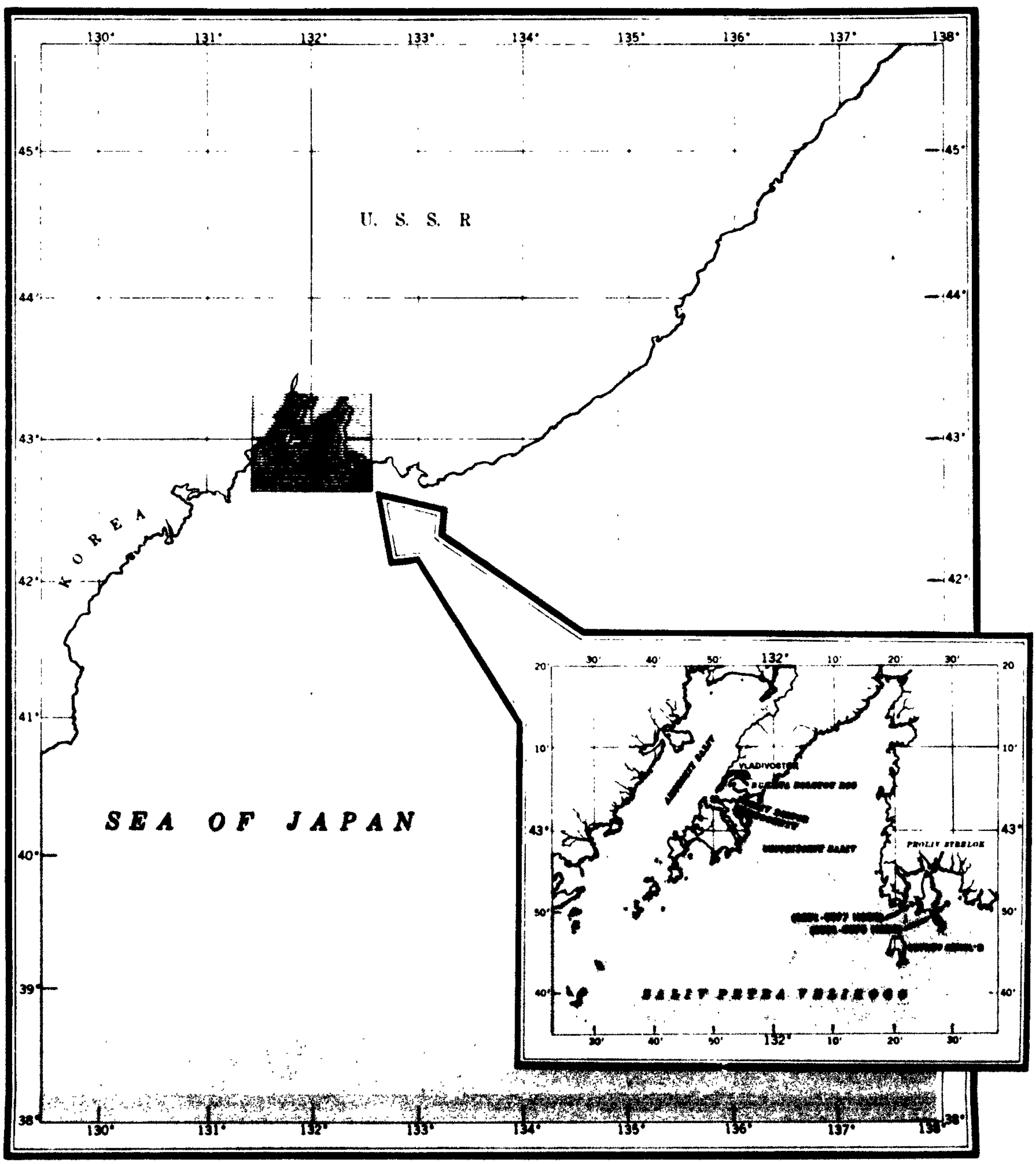
Additional Areas (Cont'd)	H.O.Call No.	NOL Lib.No.
Pacific Coastal Area of U.S.S.R. (Cont'd)		
Ust Bolskeretsk Anchorage	0194-0015	
Ust Kamchatsk Approaches	0132-0003	
Vladivostok (complex)	0291-9999 0291-0077	C-54519
Persian Gulf		
Abadan	(0444-0028)	
Al Manamah	(0547-9993)	
Bandar-e-Shahpur	(0444-0029)	
Fahayhil	(0444-9954)	
Ras at Tannura	(0547-9994)	
Strait of Malacca and Coast of Sumatra		
Balawan approaches	0501-0920	C-52037
Pangkalansusu approaches	0505-0800	C-52040
Penang (complex), Malaya	0859-9999	C-52041
Port Swettenham, South Klang Strait	0005-0920	C-52042
Port Swettenham, North Klang Strait	0006-0920	C-52042
Sabang approaches, Sumatra	0501-0800	C-52044
Sibolga approaches, Sumatra	0505-0920	C-52045
Singapore (complex), Malaya	0860-9999	C-52046

U.S. HYDROGRAPHIC – OCEANOGRAPHIC DATA SHEET

Sheet	0291-9999 HODS 0291-0076 HODS 0291-0077 HODS
Date	15 Mar. 1952
Page	1
Area	0291
Target	9999
Category	473
Latitude	43° 07′ N.
Longitude	131° 54′ E.
Elevation	Sea Level

VLADIVOSTOK (complex)
U.S.S.R.

Table of Contents



Prepared by
U.S. NAVY HYDROGRAPHIC OFFICE

1. TIDES—VLADIVOSTOK

TIDAL RANGE

Spring Range	0.7 ft.
Mean Range	0.6 ft.
Mean Sea Level	1.4 ft.

Range in tide is the difference in height between consecutive high and low waters.

Spring range is the average of the large ranges that occur fortnightly near the time of new and full moon

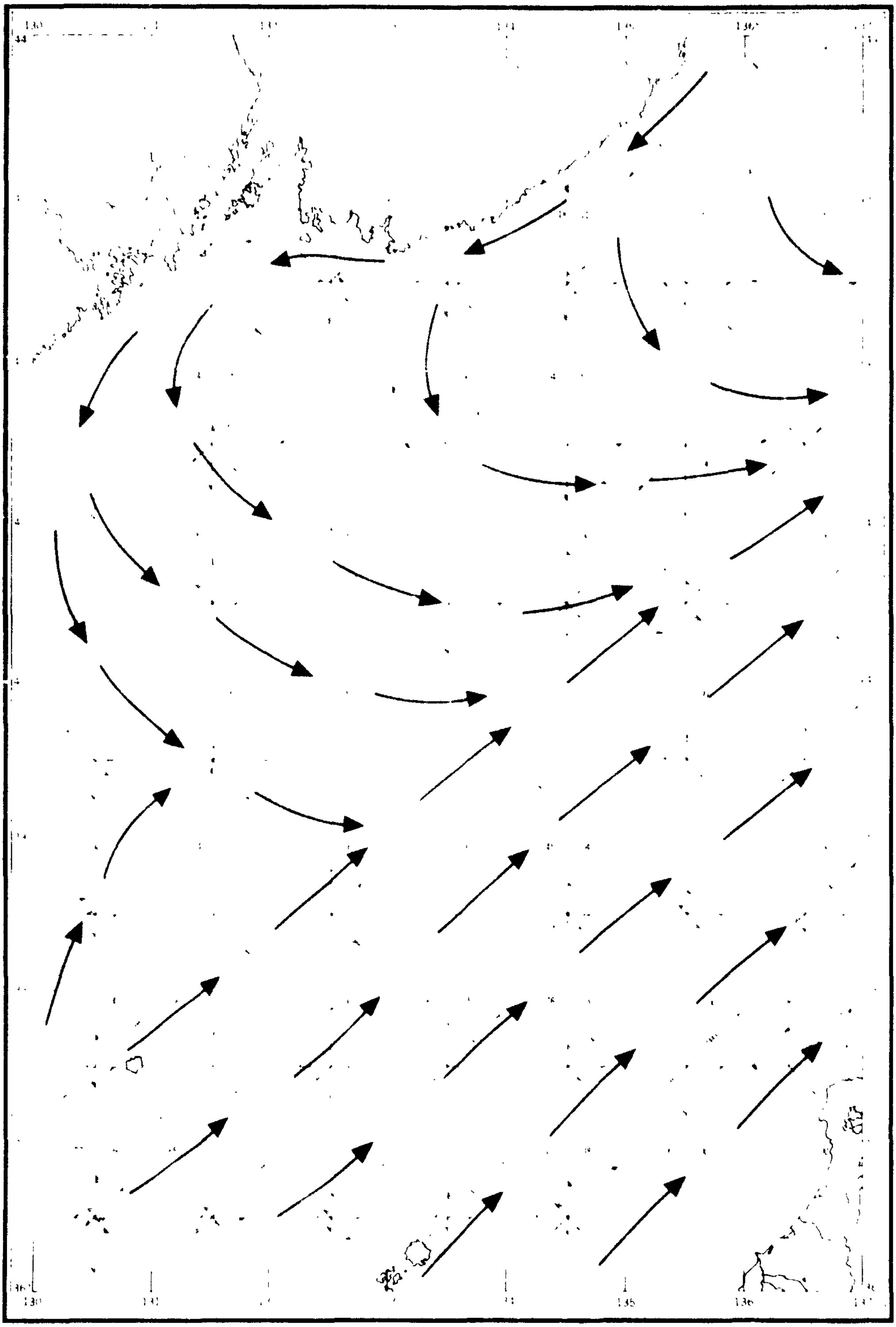
Mean range is the average range over a considerable period of time.

Mean sea level is the average height above chart datum of the surface of the sea for all stages of the tide.

NOTES

The tide at Vladivostok is mixed. Since tide ranges are small, tide curves have not been drawn. Normally in this area, greater variations in water level are caused by the wind than by the tide.

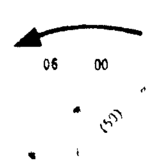
2. CURRENTS—SEA OF JAPAN



GENERAL CIRCULATION IN THE SEA OF JAPAN

LEGEND

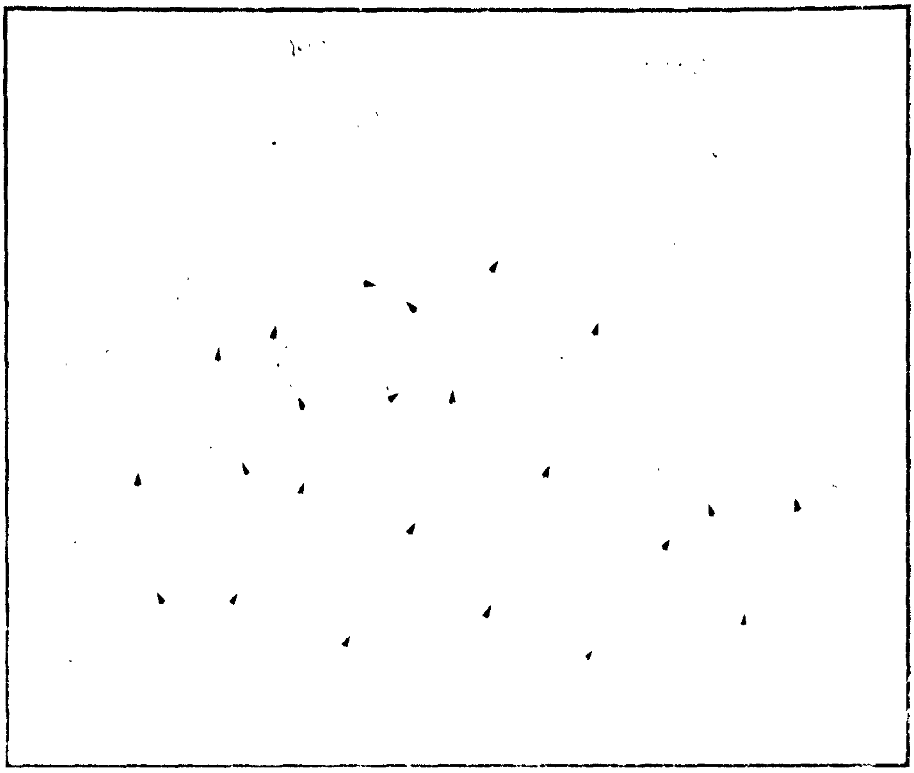
GRAY ARROWS GIVE DIRECTION OF PREVAILING CURRENTS
FIGURE IN UPPER LEFT DENOTES TOTAL NUMBER OF OBSERVATIONS
FIGURE IN UPPER RIGHT DENOTES PERCENTAGE OF "NILS"
AVERAGE CURRENT SPEED IS INDICATED BY BARBS ON BLACK ARROWS
EACH LIGHT BARB EQUALS 0.2 KNOT
EACH HEAVY BARB EQUALS 1.0 KNOT
DIRECTION OF CURRENT INDICATED BY BLACK ARROWS IS FROM THE CENTER OF THE ROSE OUTWARD
LENGTH OF BLACK ARROW DENOTES FREQUENCY OF SET ACCORDING TO SCALE BELOW

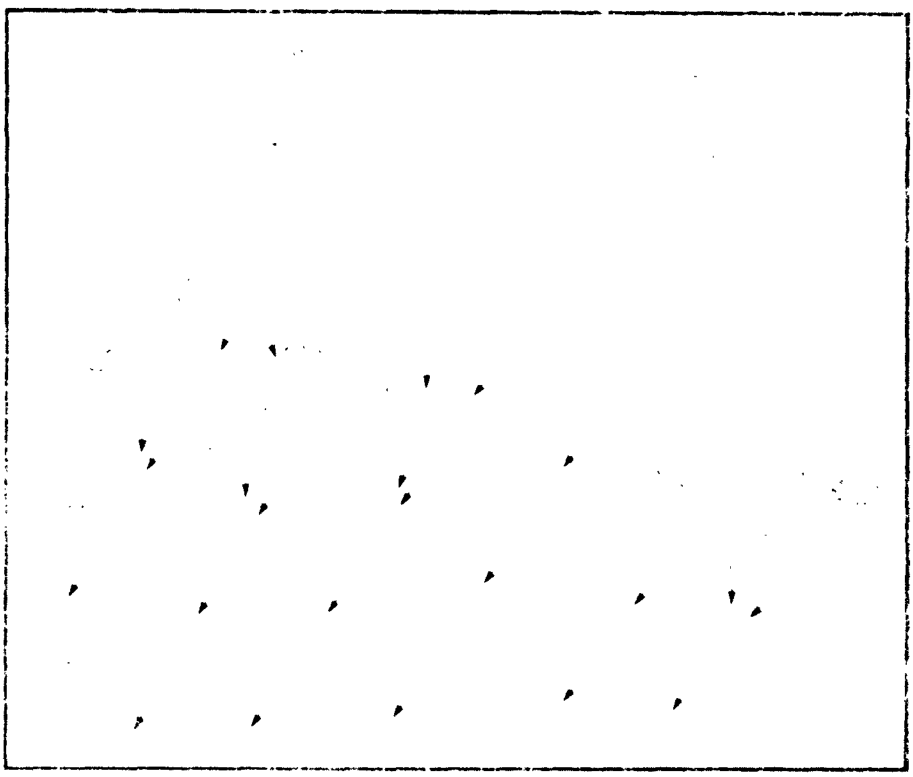


0 50 100%

IF ARROW IS BROKEN, FREQUENCY OF SET IS INDICATED BY THE NUMBER IN PARENTHESES

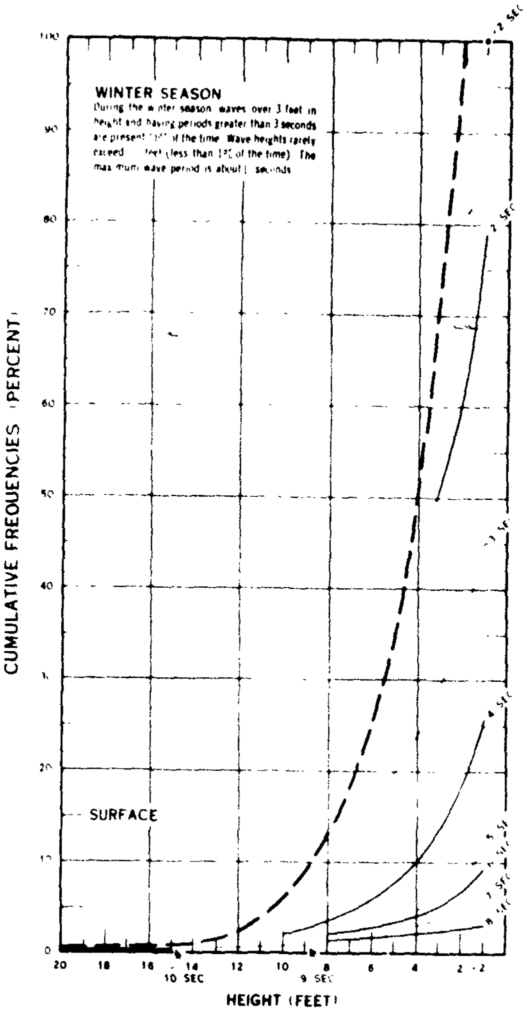
2. CURRENTS—VLADIVOSTOK

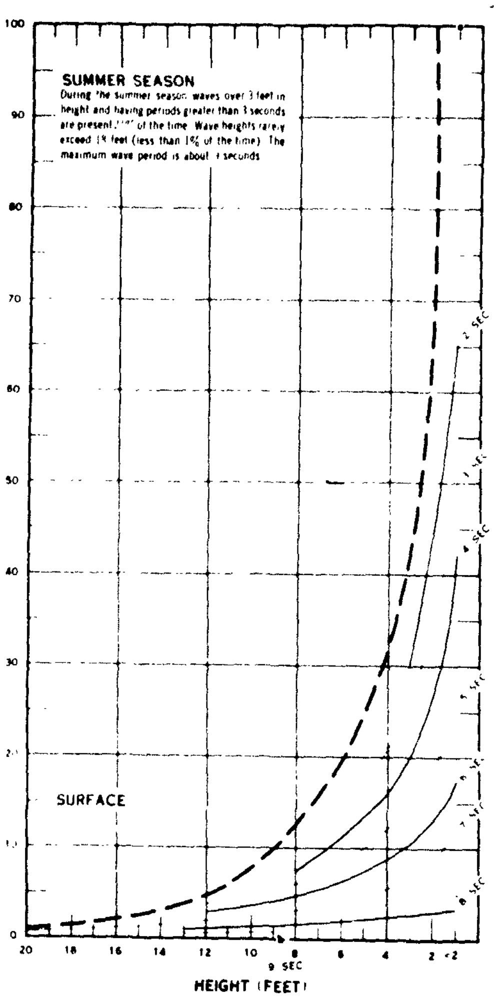




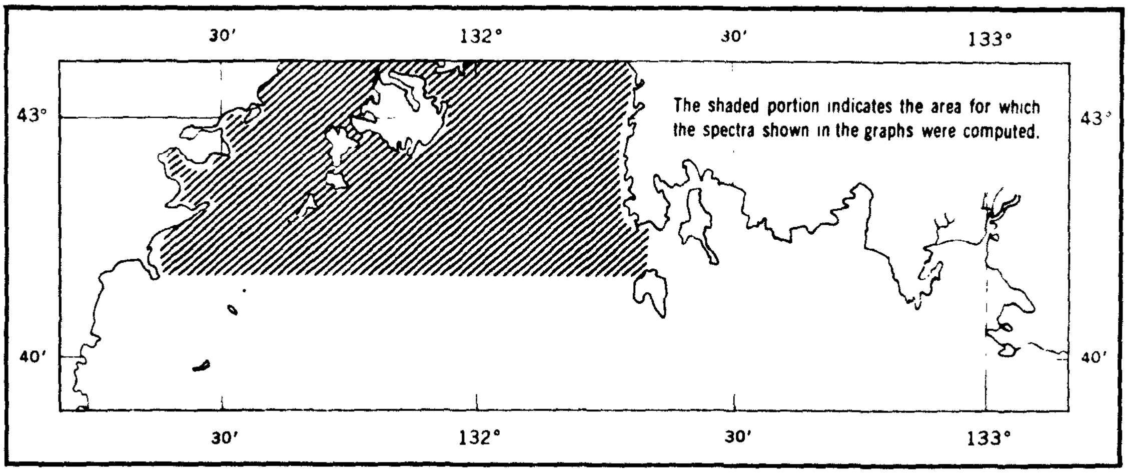
3. SEA AND SWELL—VLADIVOSTOK

Sheet	0291-9999 HODS
	0291-0076 HODS
	0291-0077 HODS
Date	15 Mar. 1952
Page	6





OCCURRENCES OF WAVES ACCUMULATED BY PERIODS AND HEIGHTS



NOTES

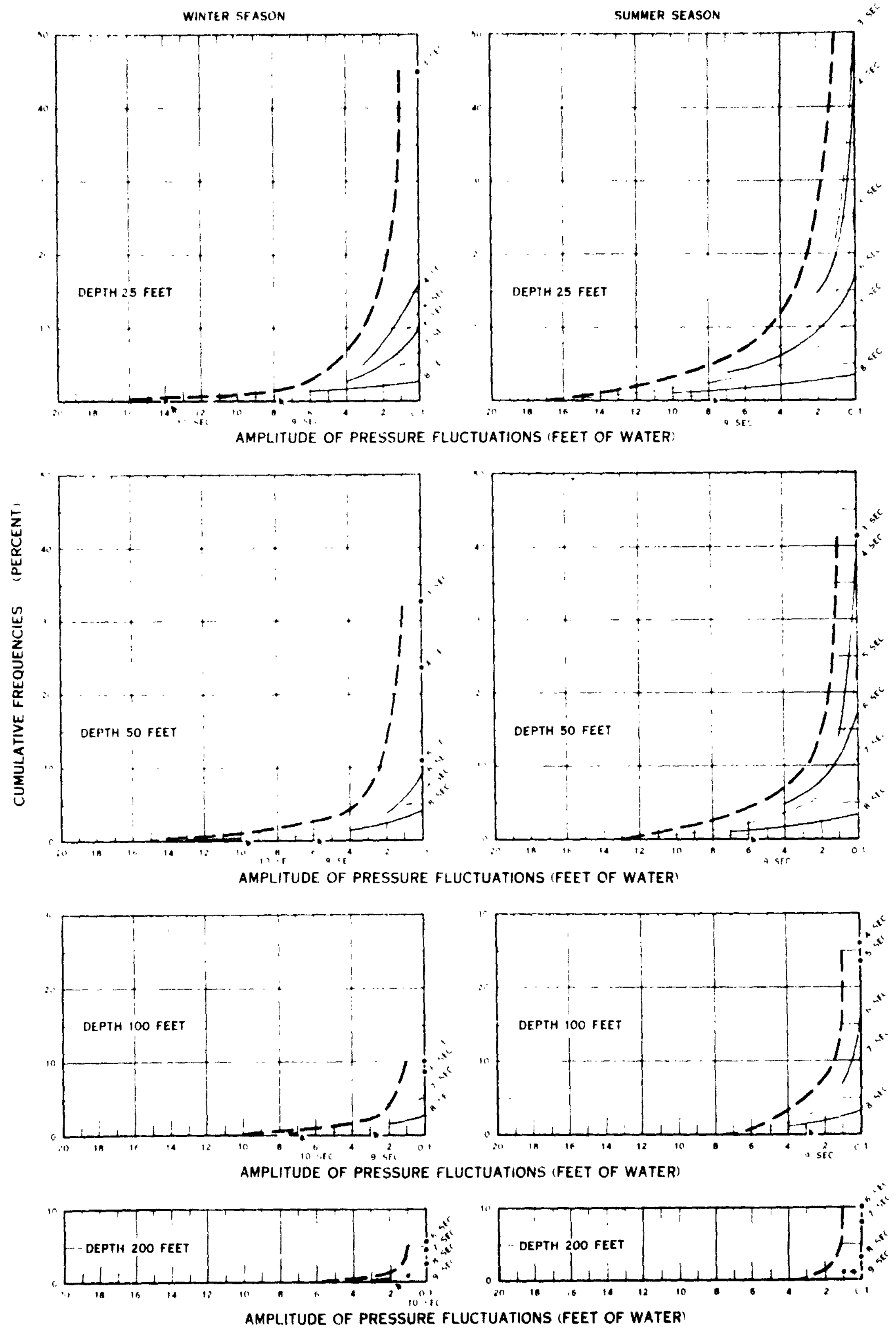
These graphs were devised to give the probability of surface waves exceeding any specified height and period combination. A given point on any curve indicates the cumulative frequency (in percent) of waves having periods and heights exceeding that of the point. The heavy dashed line indicates the limit of wave height-period combinations for the seasons and depths shown.

Graphs were computed from 8,872 ship observations of winds covering a period of 50 years. The surface graphs are for deep water areas and do not take into account modifications of the wave form that occur in shallow water.

Pressure variations associated with waves diminish with increasing depth. For example, all pressure variations resulting from wave periods that are less than 3 seconds will have disappeared at a depth of 50 feet. Pressure fluctuations of waves are transmitted to greater depths according to the increased wave period. This filtering effect is shown for various depths below the surface in the graphs on the following page.

3. SEA AND SWELL—VLADIVOSTOK (Cont'd)

PRESSURE FLUCTUATIONS ON GROUND MINES



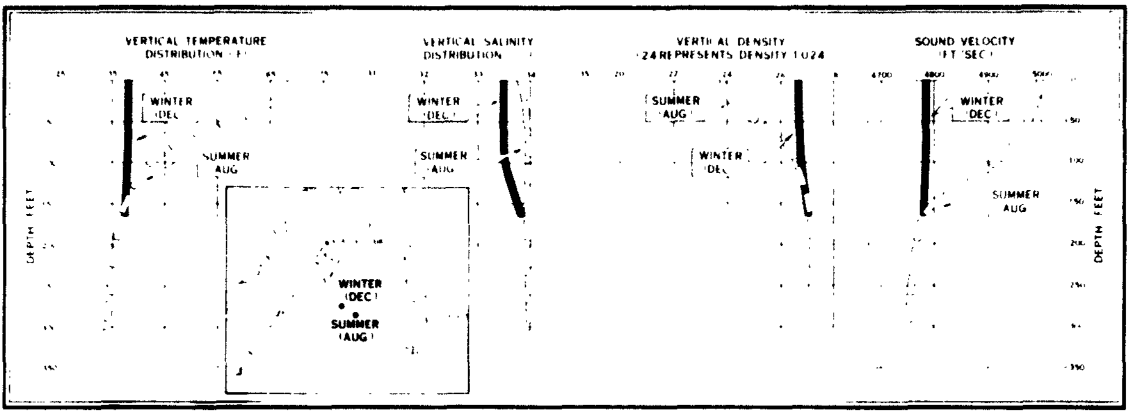
NOTES

These graphs apply to mines placed on the sea bottom (ground mines), and show the frequency of occurrence of pressure fluctuations exceeding specified height and period combinations. In these graphs, the effect of shoaling on wave heights (with consequent pressure fluctuations) has been taken into account.

4. PHYSICAL PROPERTIES—VLADIVOSTOK

Sheet	0291-9999 HODS 0291-0076 HODS 0291-0077 HODS
Date	15 Mar. 1952
Page	8

VERTICAL DISTRIBUTION OF PHYSICAL PROPERTIES



NOTES

The shaded envelopes in the above chart show the observed annual range in physical properties within the shaded area of the inset. The profiles (solid and dashed lines) are typical observations for the season and location indicated

Observations in this area indicate very weak horizontal and vertical salinity gradients. In summer there is a strong negative temperature gradient in the upper 150 feet, whereas in winter the conditions are almost isothermal

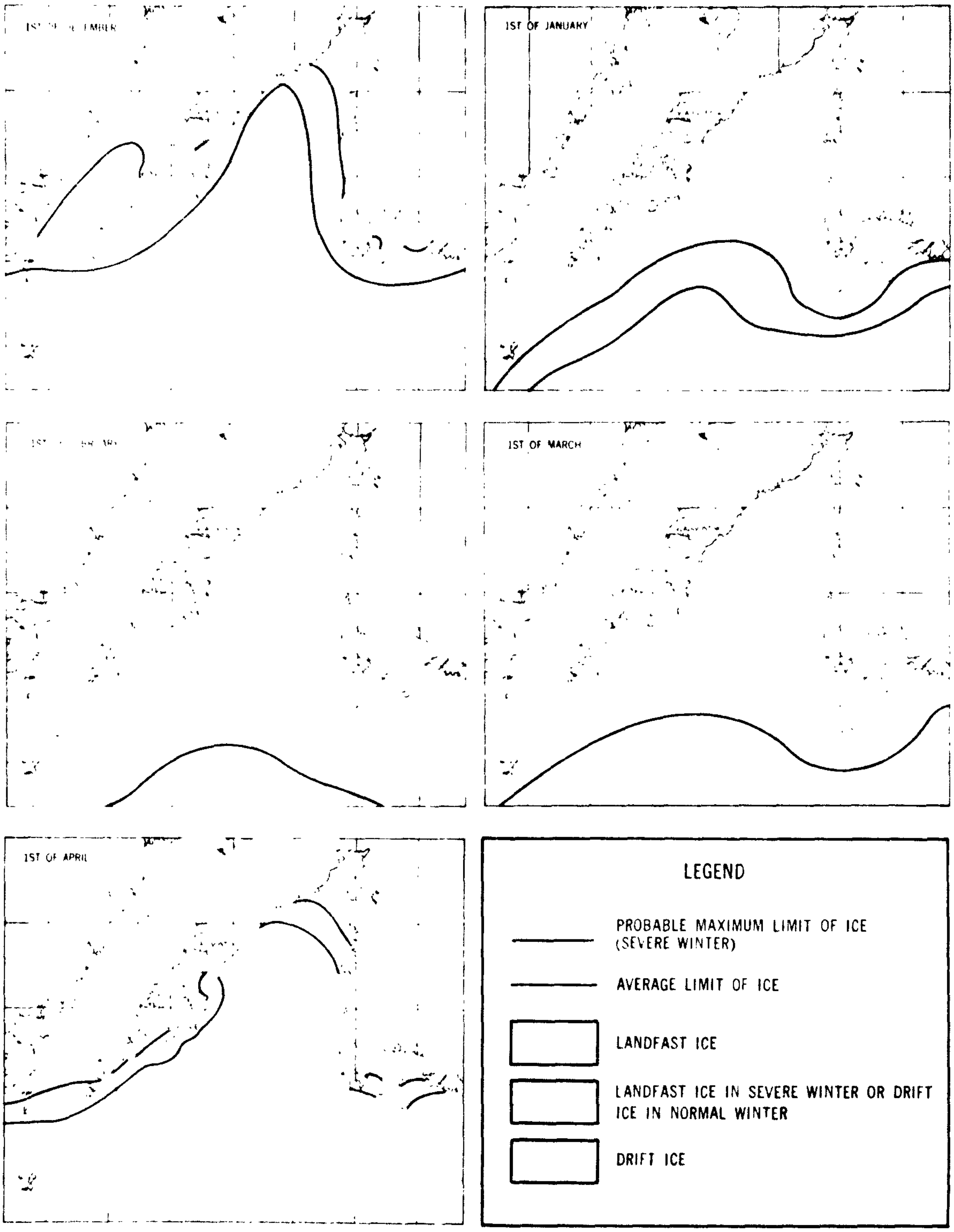
In addition to seasonal variation there are diurnal and shorter period fluctuations in temperature and salinity that appear as the result of winds, tides, and precipitation These short period variations are most pronounced in shoal inshore waters

TABLE OF SURFACE PHYSICAL PROPERTIES

	Jan	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
Temperature (°F.)												
Mean	29	29	30	34	45	55	64	70	68	59	43	35
Maximum	30	30	31	42	57	64	76	75	75	64	51	42
Minimum	28	28	29	29	39	45	61	65	59	39	33	29
Salinity (°/₀₀)												
Mean	34.2	34.3	33.8	34.0	33.3	32.6	32.4	32.2	31.7	33.0	33.3	33.7
Density												
Mean	1.0275	1.0275	1.0272	1.0273	1.0260	1.0246	1.0233	1.0223	1.0222	1.0245	1.0262	1.0270
Electrical Conductivity (mhos/cm. cube)												
Mean	.028	.028	.028	.029	.034	.038	.043	046	.044	.041	.033	.029

Sheet	0291-9999 HODS
	0291-0076 HODS
	0291-0077 HODS
Date	15 Mar. 1952
Page	9

5. ICE—VLADIVOSTOK



NOTES

As shown by the charts, ice conditions will vary considerably with the severity of the winter. Bukhta Zolotoy Rog is frozen completely an average of 86 days a year. By the middle of January, Proliv Bosfor Vostochnyy generally is frozen completely as far east as Mayak Skrypleva. Beyond this point any landfast ice that forms in Ussuriyskiy Zaliv is broken up by wave action. During the winter icebreakers maintain a channel from the open sea through the eastern entrance of Proliv Bosfor Vostochnyy as far as the harbor at Vladivostok.

5. ICE—VLADIVOSTOK (Cont'd)

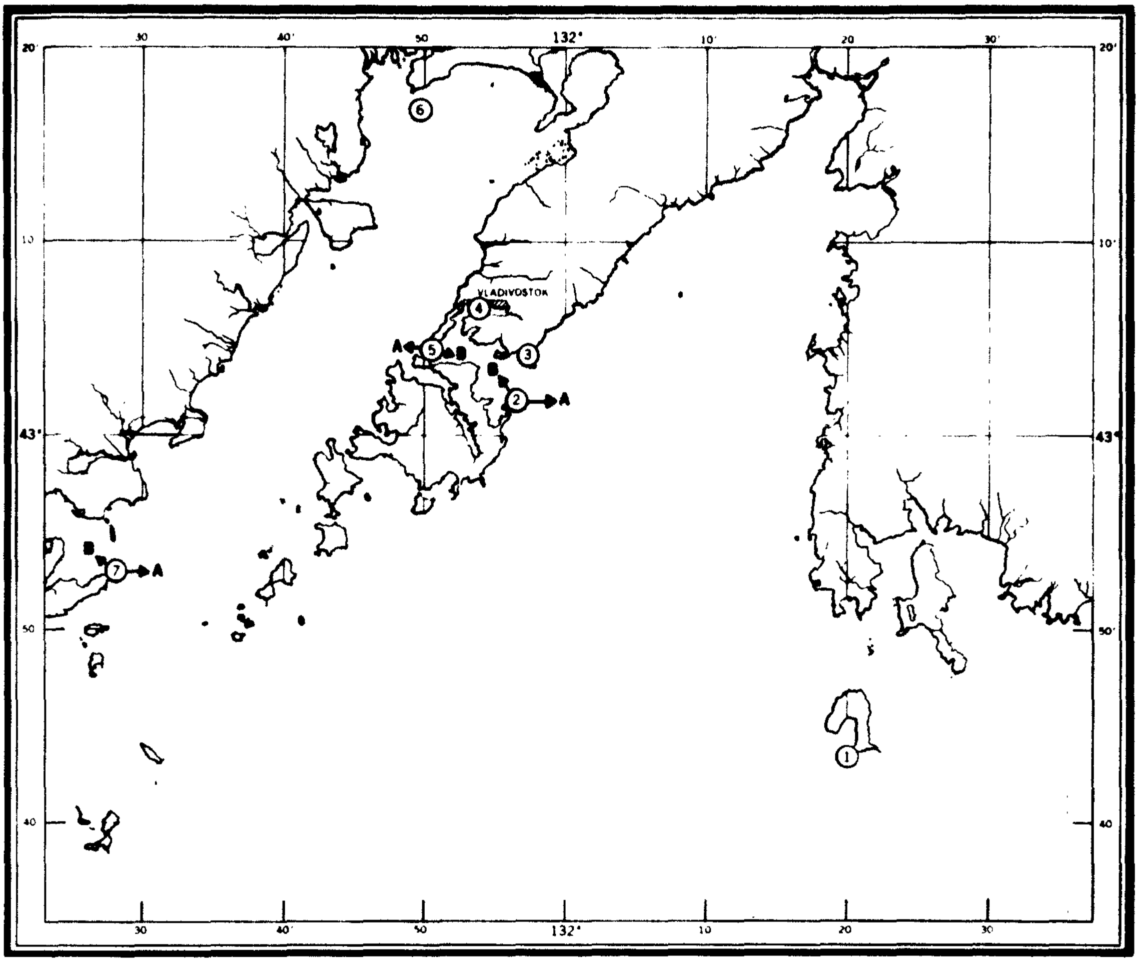
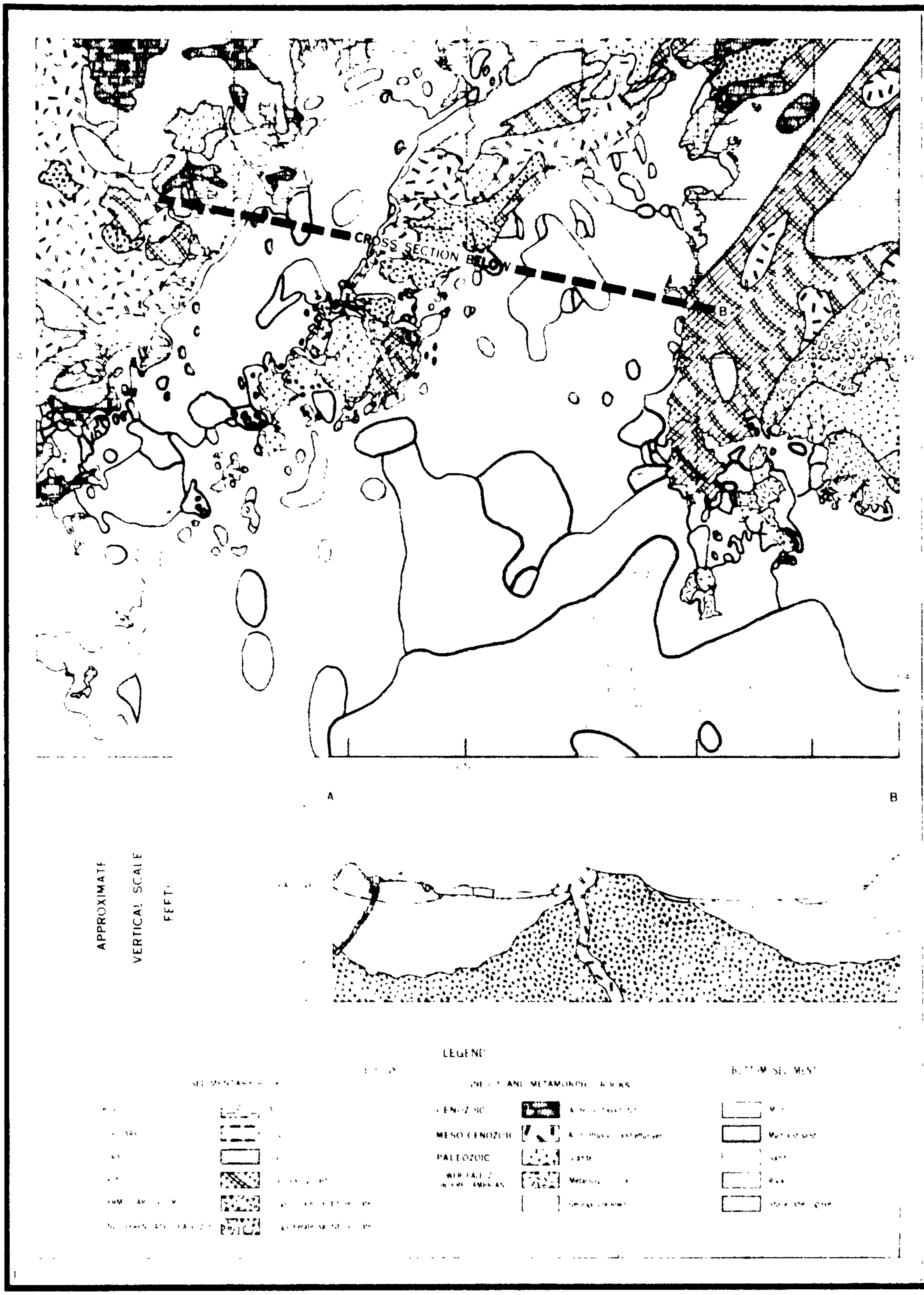


TABLE OF ICE CONDITIONS

	FIRST APPEARANCE OF ICE		COMPLETE FREEZING		FINAL ICE CLEARANCE		MAXIMUM ICE THICKNESS
	Earliest	Latest	Earliest	Latest	Earliest	Latest	Inches
1. MAYAK ASKOL'D 42°44'N, 132°21'E	Dec. 19	Jan. 10	Dec. 19	*	Feb. 6	Mar. 24	13
2. MAYAK SKRYPLEVA 43°02'N, 131°58'E							
A. USSURIYSKIY ZALIV	Dec. 14	Dec. 30	Jan. 12	*	Mar. 6	Mar. 27	-
B. PROLIV BOSFOR VOSTOCHNYY	Dec. 9	Dec. 18	Jan. 12	*	Mar. 17	Apr. 12	-
3. BUKHTA PATROKL 43°04'N, 131°58'E	Dec. 8	Dec. 16	Jan. 6	Jan. 22	Mar. 15	Mar. 29	18
4. VLADIVOSTOK (BUKHTA ZOLOTOY ROG) 43°07'N, 131°51'E	Nov. 22	Dec. 22	Dec. 5	Jan. 22	Mar. 5	Apr. 25	34
5. MAYAK TOKAREVSKOGO 43°04'N, 131°51'E							
A. AMURSKIY ZALIV	Nov. 12	Dec. 8	Dec. 18	Jan. 9	Apr. 21	Apr. 30	30
B. PROLIV BOSFOR VOSTOCHNYY	Nov. 12	Nov. 22	Dec. 20	**	Apr. 3	Apr. 30	30
6. MAYAK RECHNOY 43°18'N, 131°50'E	Nov. 12	Nov. 22	Dec. 13	Dec. 27	Apr. 7	Apr. 25	39
7. MAYAK BRYUSA 42°53'N, 131°28'E							
A. AMURSKIY ZALIV	Dec. 10	Dec. 21	Jan. 12	**	Mar. 17	Apr. 24	27
B. ZALIV SLAVYANSKIY	Nov. 24	Dec. 15	Dec. 25	Jan. 6	Apr. 9	May 16	32

*If complete freezing occurs, it seldom lasts more than one or two days.
**In very mild winters complete freezing is unlikely to occur.

6. BOTTOM SEDIMENTS AND GEOLOGY—VLADIVOSTOK



GEOLOGY

Two distinct structural trends have been recognized in the Vladivostok region (1) A series of Triassic to Miocene folds trending northeast superimposed upon (2) a series of pre-Cambrian or lower Paleozoic folded metamorphic rocks trending northwest. Numerous granite masses were intruded during the middle Paleozoic. Post Tertiary gravels are found as high as 220 feet above present sea level Wave-cut terraces 50 feet or more above the present sea level indicate uplift, probably since Tertiary time The cross section is based on the surface geologic plan and represents one possible interpretation of the vertical structure.

BOTTOM SEDIMENTS

Sand and rock are the predominant bottom types along the coast in this area Sand is the main sediment in Ussuriyskiy Zaliv and mud in the middle of Amurskiy Zaliv.

In submarine environments, the unconsolidated sediments generally are saturated with sea water, so that their electrical resistivity approaches that of sea water Sea bottom resistivity generally is predictable as high or low, depending on the permeability of the underlying rock. In a similar manner the transmission velocity of longitudinal waves is affected by the nature of the bottom sediments and underlying rock.

SPECIFIC RESISTANCES (ohms/cm. cube)

Alluvium	
Clay	100-300,000
Sand	13,300-1,000,000
Gravel	14,000-100,000
Shale	2,000-1,000,000
Sandstone	3,000-1,000,000
Conglomerate	20,000-200,000
Granite	10,000,000-10,000,000,000
Andesite	1,000,000
Basalt	100,000,000
Tuff	41,200-800,000
Sea water	18-50

VELOCITIES OF LONGITUDINAL WAVES (ft./sec.)

Alluvium	1,600-6,500
Slate and shale	7,500-15,400
Sandstone	4,600-14,100
Granite	13,000-18,700
Sea water	4,850-4,950

7. TERRESTRIAL MAGNETISM—VLADIVOSTOK

Declination—1950 .... 9°05′ West
Inclination—1945 .... 59°10′ North
Horizontal Intensity—1945 .... 26,800 gammas
Vertical Intensity—1945 .... +44,200 gammas
Geomagnetic Latitude .... 32°07′ North

Secular Changes:

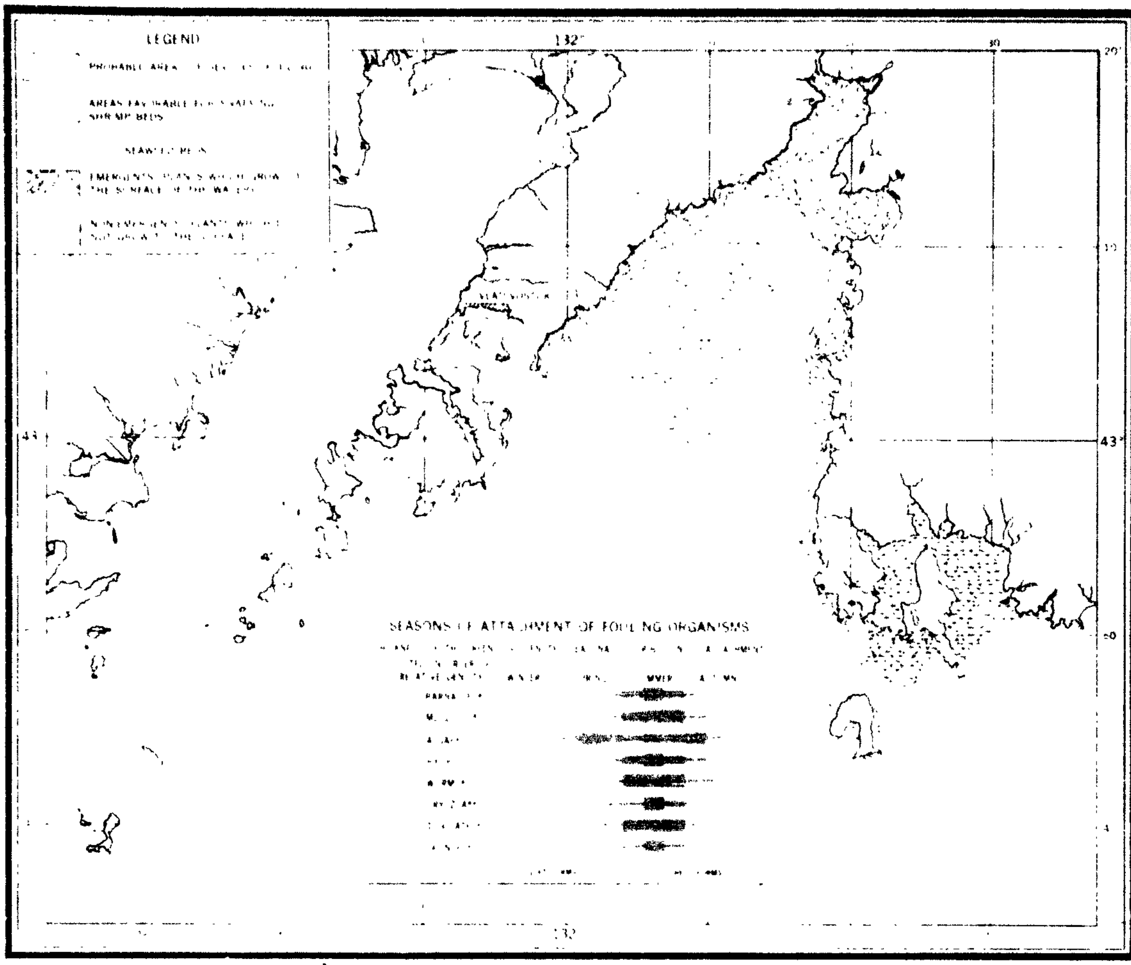
Declination—Epoch 1950 .... + 2.7 minutes/year
Inclination—Epoch 1945 .... 0.0 minutes/year
Horizontal Intensity—Epoch 1945 .... + 15.0 gammas/year
Vertical Intensity—Epoch 1945 .... + 30.0 gammas/year

NOTE

Conversion factor: 100 gammas=1 milligauss
(Example: 20.6 gammas=.206 milligauss)

(This information is provisional and will be supplemented at a later date.)

8. BIOLOGY—VLADIVOSTOK



FOULING

The period of greatest attachment by fouling organisms is during July, August, and September at which time oyster fouling is intense in the northern part of Amurskiy Zaliv. However, the period of greatest attachment by algae is from March through October. During the remainder of the year fouling by all organisms is negligible. Giant kelp (***Laminaria***), with fronds occasionally reaching a length of 50 feet or more, present an entanglement hazard throughout the year in Zaliv Ussuriyskiy, Proliv Strelok, and in the vicinity of Ostrov Askol'd. In addition to the seaweed beds indicated on the chart, other kelp beds probably occur in nearshore areas on rocky bottoms to depths of 210 feet.

SNAPPING SHRIMP

Snapping shrimp have been reported in this area and are likely to be present in the vicinity of rock bottom and seaweed beds. However, the low temperatures of the region are unfavorable for large populations. Noise levels at night are 3 to 6 decibels above daylight levels, peak intensities occurring immediately before sunrise and after sunset. There is a broad plateau in the shrimp noise spectrum between 2 and 15 kilocycles. Because of the extreme annual range of temperature, it is likely that a seasonal variation in shrimp noise exists, the maximum noise level occurring in July, August, and September.

SONIC FISHES

The principal sonic fishes of this area are mackerel, gurnards, sculpins, catfish, ocean sunfish, cod, and scorpion fish. Porpoises also are present, as are whales which visit the area occasionally in the spring and autumn. Maximum interference from fish noises occurs in the spring and summer and minimum interference in January and February. The maximum sound pressure level of fish noises is in the frequency range of 0.1 to 3.0 kilocycles.

BIOLUMINESCENCE (PHOSPHORESCENCE)

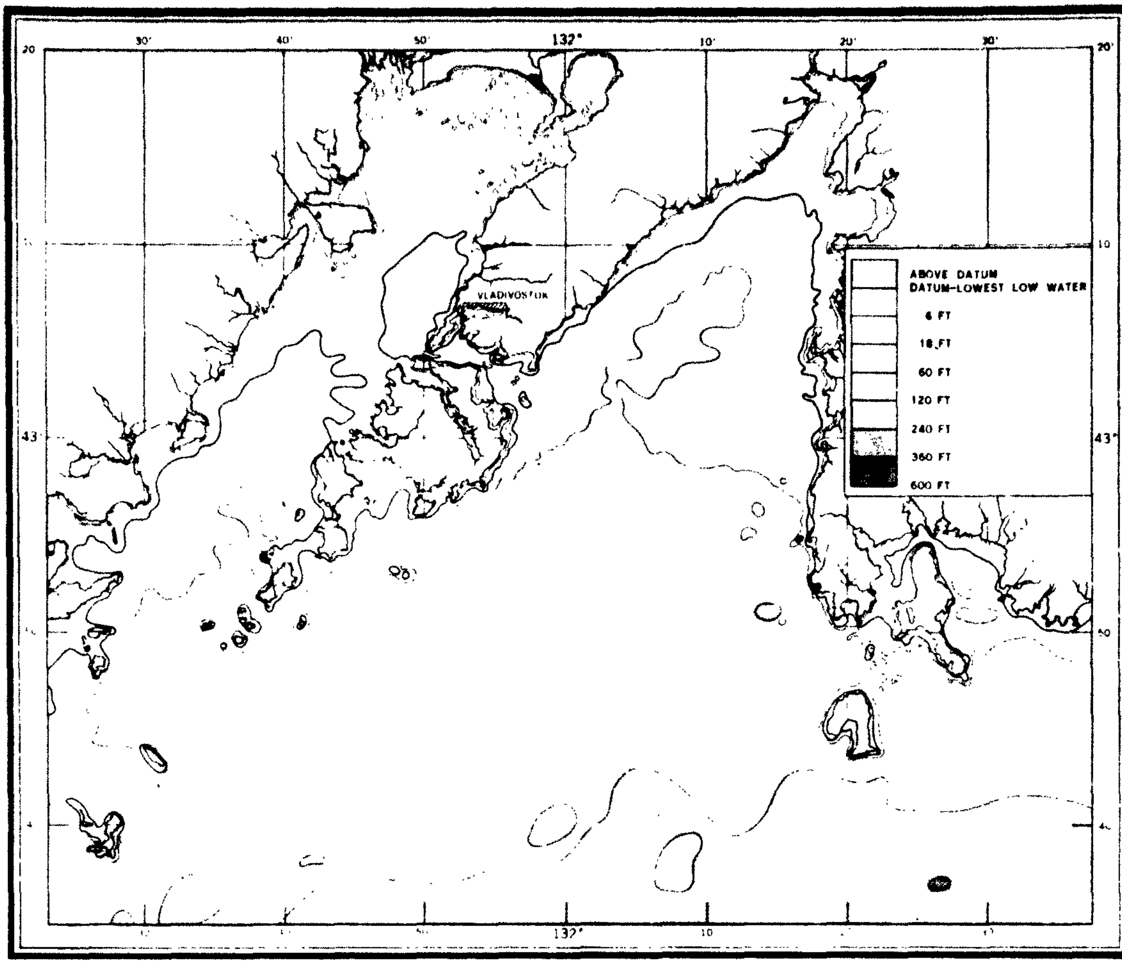
Minute marine organisms, capable of producing a brilliant luminescence especially when the water is agitated, are present in large numbers in the summer months. Luminescence in the wakes of ships and submarines probably occurs frequently during July, August, and September.

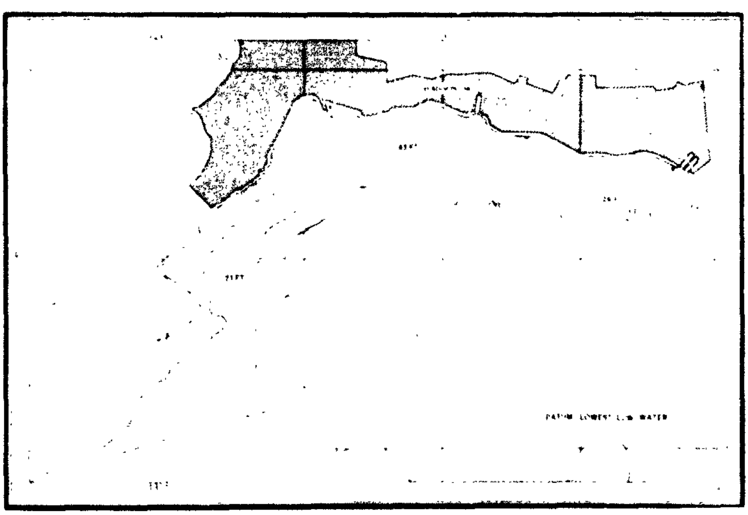
WATER COLOR AND TRANSPARENCY

The offshore water color varies from green-blue to blue-green with slight seasonal variation. The color of the inshore waters is normally blue-green, changing to yellow-green during the period of maximum river discharge in June, July, and August. During this period the waters adjacent to the mouths of the larger rivers are a muddy yellow color.

Transparency of offshore waters does not exceed 15. During June, July, and August the transparency inshore is less than 5. During the remainder of the year transparency inshore varies from 5 to 10. These figures represent the depth in meters at which a white disc (Secchi disc) about 30 cm. in diameter just disappears from sight when lowered into the water.

9. BATHYMETRY AND WATER EXCHANGE—VLADIVOSTOK





AVERAGE HARBOR DEPTHS

WATER EXCHANGE TABLE

Harbor area	64,000,000 sq. ft	1.8 ft.	115,000,000 cu. ft.
Harbor volume	2,780,000,000 cu. ft.	1.4 ft.	90,000,000 cu. ft.

The harbor volume is computed at chart datum and is based on the area for which depths are shown on the harbor chart. The high water spring height of 1.8 feet and the mean level height of 1.4 feet increase the volume shown above as follows:

A low rate of water exchange is indicated by the negligible river discharge, small tidal range, weak currents, and the protected nature of the harbor. The rates of water exchange in Amurskiy Zaliv and Proliv Bosfor Vostochnyy anchorages are controlled by the prevailing currents.